Article:

Huang, M. orcid.org/0000-0003-1960-4552, Xie, J. orcid.org/0000-0001-5937-0936, Romdhani, H. orcid.org/0000-0001-5219-2612 et al. (7 more authors) (2025) Global assessment of health utilities associated with pneumococcal disease in children—targeted literature reviews. PharmacoEconomics. ISSN 1170-7690

https://doi.org/10.1007/s40273-025-01504-0

Supplementary Documents for

Global assessment of health utilities associated with pneumococcal disease in children — Targeted literature reviews

Journal: *PharmacoEconomics*

Min Huang[1], Jipan Xie[2], Hela Romdhani[3], Yan Song[3], Sun Lee[3], Daisy Liu[3], Elamin Elbasha[1], Salini Mohanty[1], Donna Rowen[4], Matthew S Kelly[5]

1. Merck & Co., Inc., Rahway, NJ, USA
2. XL Source, Inc., Los Angeles, CA, USA
3. Analysis Group, Inc., Boston, MA, USA
4. Sheffield Centre for Health and Related Research, University of Sheffield, Sheffield, UK
5. Division of Pediatric Infectious Diseases, Duke University School of Medicine, Durham, NC, USA

Corresponding Author:

Min Huang, PhD
+1 215-652-5974
min_huang@merck.com

Detailed search strategies

Supplementary Table 1. Search strategy to identify CUA of pneumococcal vaccines

Database searched: Ovid MEDLINE and In-Process, In-Data-Review & Other Non-Indexed Citations and Daily

Search date: June 11, 2024

#	Search Terms	Counts
Disease terms		
1	(strep* pneumo*).ab,ti or (S pneumo*).ab,ti or (pneumococc*).ab,ti or (PCV).ab,ti	54,581
2	(inpatient pneumonia or hospitalized pneumonia or outpatient pneumonia or nonhospitalized pneumonia or all-cause pneumonia or clinical pneumonia or community-acquired pneumonia or NBPP).ab,ti	12,916
3	(bacteremia or bacteraemia).ab,ti	34,757
4	(otitis media or AOM).ab,ti	26,225
5	(meningitis).ab,ti	59,142
6	(hearing loss AND sequela*).ab,ti or (auditory AND sequela*).ab,ti or (neurological AND sequela*).ab,ti	10,124
7	1 or 2 or 3 or 4 or 5 or 6	178,998
Cost terms		
8	7 and (cost* or economic burden).ab,ti	5,299
9	7 and (productivity or absen* or sick leave or sick day*).ab,ti	5,929
10	8 or 9	**10,967**
Filters		
11	10 not (Animals/ not Humans/) not ((comment or editorial or practice-guideline or letter or conference or abstract).pt. or (case study or case report).tw.)	9,291
12	limit 10 to english language	8,871
13	limit 12 to yr="2010-Current"	5,138
14	remove duplicates from 13	**5,121**

Abbreviations: CUA=Cost-Utility Analysis; PCV=Pneumococcal Conjugate Vaccine; NBPP=Non-Bacteremic Pneumococcal Pneumonia; AOM=Acute Otitis Media.

Notes:

This literature search identifies the cost studies on pneumococcal disease and post-meningitis sequelae, and cost-effectiveness analysis and budget impact analysis of pneumococcal vaccines.

Supplementary Table 2. Search strategy to identify original research studies on health utility associated with pneumococcal disease

Database searched: Ovid MEDLINE and In-Process, In-Data-Review & Other Non-Indexed Citations and Daily

Search date: June 11, 2024

#	Search Terms	Counts
Disease terms		
1	(strep* pneumo*).ab,ti or (S pneumo*).ab,ti or (pneumococc*).ab,ti or (PCV).ab,ti	54,581
2	(inpatient pneumonia or hospitalized pneumonia or outpatient pneumonia or nonhospitalized pneumonia or all-cause pneumonia or clinical pneumonia or community-acquired pneumonia or NBPP).ab,ti	12,916
3	(bacteremia or bacteraemia).ab,ti	34,757
4	(otitis media or AOM).ab,ti	26,225
5	(meningitis).ab,ti	59,142
6	(hearing loss AND sequela*).ab,ti or (auditory AND sequela*).ab,ti or (neurological AND sequela*).ab,ti	10,124
7	1 or 2 or 3 or 4 or 5 or 6	178,998
Utility terms		
8	7 and (utilit* or Utilit* or quality adjusted life or QALY* or QALE* or QALD* or QoL or HRQoL or quality of life or quality-of-life).ab,ti	3,179
9	7 and (EQ-5D or SF-6D, or SF-12 or SF-36 or HUI or time trade off or TTO or standard gamble).ab,ti	100
10	8 or 9	**3,205**
Filters		
11	10 not (Animals/ not Humans/) not ((comment or editorial or practice-guideline or letter or conference or abstract).pt. or (case study or case report).tw.)	2,905
12	limit 11 to english language	2,774
13	limit 12 to yr="2019-Current"	1,035
14	remove duplicates from 13	**1,027**

Abbreviations: PCV=Pneumococcal Conjugate Vaccine; NBPP=Non-Bacteremic Pneumococcal Pneumonia; AOM=Acute Otitis Media; QALY=Quality-Adjusted Life Year; QALE=Quality-Adjusted Life Expectancy; QALD=Quality-Adjusted Life Day; QoL=Quality of Life; HRQoL=Health-Related Quality of Life; EQ-5D=EuroQol 5-Dimension; SF-6D=Short Form 6-Dimension; SF-12=Short Form 12-Item Health Survey; SF-36=Short Form 36-Item Health Survey; HUI=Health Utilities Index; TTO=Time Trade-Off.

This literature search identifies the recently published literature reviews and original research studies on health utility of pneumococcal disease. The current review included the original research studies on health utility of pneumococcal disease identified in the literature search and referenced in the published literature reviews.

List of studies from the literature reviews

Supplementary Table 3. List of included studies on CUA of pneumococcal vaccines in children

First author	Publication Year	Country	Age group	Health states included	Reference
Ray GT	2006	US	Pediatric	IPD, pneumonia, AOM	Ray GT, Whitney CG, Fireman BH, Ciuryla V, Black SB. Cost-effectiveness of pneumococcal conjugate vaccine: evidence from the first 5 years of use in the United States incorporating herd effects. Pediatr Infect Dis J. 2006 Jun;25(6):494-501. doi: 10.1097/01.inf.0000222403.42974.8b. PMID: 16732146.
O'Brien MA	2009	US	Pediatric	IPD, pneumonia, AOM	O'Brien MA, Prosser LA, Paradise JL, Ray GT, Kulldorff M, Kurs-Lasky M, Hinrichsen VL, Mehta J, Colborn DK, Lieu TA. New vaccines against otitis media: projected benefits and cost-effectiveness. Pediatrics. 2009 Jun;123(6):1452-63. doi: 10.1542/peds.2008-1482. PMID: 19482754.
Rubin JL	2010a	US	Pediatric	IPD, pneumonia, AOM and PMS	Rubin JL, McGarry LJ, Strutton DR, Klugman KP, Pelton SI, Gilmore KE, Weinstein MC. Public health and economic impact of the 13-valent pneumococcal conjugate vaccine (PCV13) in the United States. Vaccine. 2010 Nov 10;28(48):7634-43. doi: 10.1016/j.vaccine.2010.09.049. Epub 2010 Sep 28. PMID: 20883739.
Rubin JL	2010b	US	Pediatric	IPD, pneumonia, AOM and PMS	Rubin JL, McGarry LJ, Klugman KP, et al. Public health and economic impact of vaccination with 7-valent pneumococcal vaccine (PCV7) in the context of the annual influenza epidemic and a severe influenza pandemic. BMC Infect Dis. 2010 Jan 21;10:14.

Stoecker C	2013	US	Pediatric	IPD, pneumonia, AOM and PMS	Stoecker C, Hampton LM, Link-Gelles R, Messonnier ML, Zhou F, Moore MR. Cost-effectiveness of using 2 vs 3 primary doses of 13-valent pneumococcal conjugate vaccine. Pediatrics. 2013 Aug;132(2):e324-32. doi: 10.1542/peds.2012-3350. Epub 2013 Jul 1. PMID: 23821695.
McGarry LJ	2013	US	Pediatric	IPD, pneumonia, and PMS	McGarry LJ, Gilmore KE, Rubin JL, Klugman KP, Strutton DR, Weinstein MC. Impact of 13-valent pneumococcal conjugate vaccine (PCV13) in a pandemic similar to the 2009 H1N1 in the United States. BMC Infect Dis. 2013 May 21;13:229. doi: 10.1186/1471-2334-13-229. PMID: 23687999; PMCID: PMC3668995.
Huang M	2023	US	Pediatric	IPD, pneumonia, AOM and PMS	Huang M, Hu T, Weaver J, Owusu-Edusei K, Elbasha E. Cost-Effectiveness Analysis of Routine Use of 15-Valent Pneumococcal Conjugate Vaccine in the US Pediatric Population. Vaccines (Basel). 2023 Jan 6;11(1):135. doi: 10.3390/vaccines11010135. PMID: 36679980; PMCID: PMC9861214.
Prasad N	2023	US	Pediatric	IPD, pneumonia, AOM and PMS	Prasad N, Stoecker C, Xing W, Cho BH, Leidner AJ, Kobayashi M. Public health impact and cost-effectiveness of 15-valent pneumococcal conjugate vaccine use among the pediatric population of the United States. Vaccine. 2023 May 2;41(18):2914-2921.
Rozenbaum MH	2024a	US	Pediatric	IPD, pneumonia, and AOM	Rozenbaum MH, Chilson E, Farkouh R, Huang L, Cane A, Arguedas A, Tort MJ, Snow V, Averin A, Weycker D, Hariharan D, Atwood M. Cost-Effectiveness of 20-Valent Pneumococcal Conjugate Vaccine Among US Children with Underlying Medical Conditions. Infect Dis Ther. 2024 Apr;13(4):745-760. doi: 10.1007/s40121-024-00944-z. Epub 2024 Mar 16.
Rozenbaum MH	2024b	US	Pediatric	IPD, pneumonia, AOM and PMS	Rozenbaum MH, Huang L, Cane A, Arguedas A, Chapman R, Dillon-Murphy D, Tort MJ, Snow V, Chilson E, Farkouh R. Cost-effectiveness and impact on infections and associated antimicrobial resistance of 20-valent pneumococcal conjugate vaccine in US children

					previously immunized with PCV13. J Med Econ. 2024 Jan-Dec;27(1):644-652. doi: 10.1080/13696998.2024.2339638. Epub 2024 Apr 19.
Rozenbaum MH	2024c	US	Pediatric	IPD, pneumonia, AOM and PMS	Rozenbaum MH, Huang L, Perdrizet J, Cane A, Arguedas A, Hayford K, Tort MJ, Chapman R, Dillon-Murphy D, Snow V, Chilson E, Farkouh RA. Cost-effectiveness of 20-valent pneumococcal conjugate vaccine in US infants. Vaccine. 2024 Jan 25;42(3):573-582. doi: 10.1016/j.vaccine.2023.12.057. Epub 2024 Jan 7.
Poirier B	2009	Canada	Pediatric	IPD, pneumonia, AOM and PMS	Poirier B, De Wals P, Petit G, Erickson LJ, Pépin J. Cost-effectiveness of a 3-dose pneumococcal conjugate vaccine program in the province of Quebec, Canada. Vaccine. 2009;27(50):7105–7109
De Wals P	2009	Canada	Pediatric	IPD, pneumonia, AOM and PMS	De Wals, P., et al. Simulation model for comparing the costs and effectiveness of different pneumococcal conjugate vaccines. Procedia in Vaccinology, 2009. 1, 67-72.
Chuck AW	2010	Canada	Pediatric	IPD, pneumonia, AOM and PMS	Chuck, A.W., et al., Pharmacoeconomic evaluation of 10- and 13-valent pneumococcal conjugate vaccines. Vaccine, 2010. 28(33): p. 5485-90.
Earnshaw SR	2012	Canada	Pediatric	PMS	Earnshaw, S.R., et al., Cost-effectiveness of 2 + 1 dosing of 13-valent and 10-valent pneumococcal conjugate vaccines in Canada. BMC Infectious Diseases, 2012. 12: p. 101.
Wilson M	2018	Canada	Pediatric	IPD, pneumonia, AOM and PMS	Wilson M, Wasserman M, Jadavi T, Postma M, Breton MC, Peloquin F, Earnshaw S, McDade C, Sings H, Farkouh R. Clinical and Economic Impact of a Potential Switch from 13-Valent to 10-Valent Pneumococcal Conjugate Infant Vaccination in Canada. Infect Dis Ther. 2018 Sep;7(3):353-371. doi: 10.1007/s40121-018-0206-1. Epub 2018 Jun 22. PMID: 29934878; PMCID: PMC6098750.

Lytle D	2023	Canada	Pediatric	IPD, pneumonia, AOM and PMS	Lytle D, Grajales Beltrán AG, Perdrizet J, Ait Yahia N, Cane A, Yarnoff B, Chapman R. Cost-effectiveness analysis of PCV20 to prevent pneumococcal disease in the Canadian pediatric population. Hum Vaccin Immunother. 2023 Aug;19(2):2257426. doi: 10.1080/21645515.2023.2257426. Epub 2023 Sep 29.
Melegaro A	2004	UK	Pediatric	IPD, pneumonia, AOM and PMS	Melegaro A, Edmunds WJ. Cost-effectiveness analysis of pneumococcal conjugate vaccination in England and Wales. Vaccine. 2004 Oct 22;22(31-32):4203-14. doi: 10.1016/j.vaccine.2004.05.003. PMID: 15474710.
Van Hoek AJ	2012	UK	Pediatric	IPD, pneumonia, AOM and PMS	van Hoek, A.J., et al., The cost-effectiveness of a 13-valent pneumococcal conjugate vaccination for infants in England. Vaccine, 2012. 30(50): p. 7205-13.
Rozenbaum MH	2012	UK	Pediatric and Adult	IPD, pneumonia, and PMS	Rozenbaum, M.H., et al. Vaccination of risk groups in England using the 13 valent pneumococcal conjugate vaccine: economic analysis (Structured abstract). Bmj, 2012. 345, e6879.
Delgleize E	2016	UK	Pediatric	IPD, pneumonia, AOM and PMS	Delgleize E, Leeuwenkamp O, Theodorou E, et alCost-effectiveness analysis of routine pneumococcal vaccination in the UK: a comparison of the PHiD-CV vaccine and the PCV-13 vaccine using a Markov modelBMJ Open 2016;6:e010776. doi: 10.1136/bmjopen-2015-010776
Wilson M	2023	UK	Pediatric	IPD, pneumonia, and AOM	Wilson M, Lucas A, Mendes D, Vyse A, Mikudina B, Czudek C, Ellsbury GF, Perdrizet J. Estimating the Cost-Effectiveness of Switching to Higher-Valency Pediatric Pneumococcal Conjugate Vaccines in the United Kingdom. Vaccines (Basel). 2023 Jun 28;11(7):1168. doi: 10.3390/vaccines11071168.
Claes C	2009	Germany	Pediatric	IPD, pneumonia, AOM and PMS	Claes, C., R.R. Reinert, and J.M. von der Schulenburg, Cost effectiveness analysis of heptavalent pneumococcal conjugate vaccine in Germany considering herd immunity effects. European Journal of Health Economics, 2009. 10(1): p. 25-38.

Kuhlmann A	2017	Germany	Pediatric	IPD, pneumonia, AOM and PMS	Kuhlmann A, von der Schulenburg JMG. Modeling the cost-effectiveness of infant vaccination with pneumococcal conjugate vaccines in Germany. Eur J Health Econ 2017;18:273e92.
Ta A	2024	Germany	Pediatric	IPD, pneumonia, AOM and PMS	Ta A, Kühne F, Laurenz M, von Eiff C, Warren S, Perdrizet J. Cost-effectiveness of PCV20 to Prevent Pneumococcal Disease in the Pediatric Population: A German Societal Perspective Analysis. Infect Dis Ther. 2024 Jun;13(6):1333-1358. doi: 10.1007/s40121-024-00977-4. Epub 2024 May 11.
Ansaldi F	2020	Italy	Pediatric and Adult	IPD, pneumonia, AOM and PMS	Ansaldi F, Pugh S, Amicizia D, Di Virgilio R, Trucchi C, Orsi A, Zollo A, Icardi G. Estimating the Clinical and Economic Impact of Switching from the 13-Valent Pneumococcal Conjugate Vaccine (PCV13) to the 10-Valent Pneumococcal Conjugate Vaccine (PCV10) in Italy. Pathogens. 2020 Jan 22;9(2):76. doi: 10.3390/pathogens9020076. PMID: 31979079; PMCID: PMC7168640.
Castiglia P	2017	Italy	Pediatric	IPD, pneumonia, AOM and PMS	Castiglia P, Pradelli L, Castagna S, Freguglia V, Palu G, Esposito S. Overall effectiveness of pneumococcal conjugate vaccines: an economic analysis of PHiD-CV and PCV-13 in the immunization of infants in Italy. Hum Vaccin Immunother 2017:0.
Diez-Domingo J	2011	Spain	Pediatric	IPD, pneumonia, AOM and PMS	Diez-Domingo, J., et al., Pharmacoeconomic assessment of implementing a universal PCV-13 vaccination programme in the Valencian public health system (Spain). Vaccine, 2011. 29(52): p. 9640-8.
Beutels P	2011	Belgium	Pediatric	IPD, pneumonia, AOM and PMS	Beutels P, Blommaert A, Hanquet G, Bilcke J, Thiry N, Sabbe M, et al. Cost effectiveness of 10- and 13-valent pneumococcal conjugate vaccines in childhood KCE Reports. 2011. p. 155C.
Bos JM	2003	Netherlands	Pediatric	IPD and PMS	Bos, J.M., et al., Epidemiologic impact and cost-effectiveness of universal infant vaccination with a 7-valent conjugated pneumococcal vaccine in the

					Netherlands. Clinical Therapeutics, 2003. 25(10): p. 2614-30.
Hubben GA	2007	Netherlands	Pediatric	IPD and PMS	Hubben, G.A., et al. Enhanced decision support for policy makers using a web interface to health-economic models: illustrated with a cost-effectiveness analysis of nation-wide infant vaccination with the 7-valent pneumococcal conjugate vaccine in the Netherlands (Structured abstract). Vaccine, 2007. 25, 3669-3678.
Rozenbaum MH	2010a	Netherlands	Pediatric	IPD, pneumonia, AOM and PMS	Rozenbaum, M.H., et al. Cost effectiveness of pneumococcal vaccination among Dutch infants: an economic analysis of the seven valent pneumococcal conjugated vaccine and forecast for the 10 valent and 13 valent vaccines (Structured abstract). Bmj, 2010. 340:c2509.
Rozenbaum MH	2010b	Netherlands	Pediatric	IPD, pneumonia, AOM and PMS	Rozenbaum, M.H., et al., Huge impact of assumptions on indirect effects on the cost-effectiveness of routine infant vaccination with 7-valent conjugate vaccine (Prevnar). Vaccine, 2010. 28(12): p. 2367-9.
Vermer P	2014	Netherlands	Pediatric	PMS	Vemer, P. and M.J. Postma, A few years later. Update of the cost-effectiveness of infant pneumococcal vaccination in Dutch children. Human vaccines & Immunotherapeutics, 2014. 10(7): p. 1841-9.
Ess SM	2003	Switzerland	Pediatric	PMS	Ess, S.M., et al., Cost-effectiveness of a pneumococcal conjugate immunisation program for infants in Switzerland. Vaccine, 2003. 21(23): p. 3273-81
Blank PR	2012	Switzerland	Pediatric	IPD, pneumonia, AOM and PMS	Blank, P.R. and T.D. Szucs, Cost-effectiveness of 13-valent pneumococcal conjugate vaccine in Switzerland. Vaccine, 2012. 30(28): p. 4267-75.
Warren S	2023	Greece	Pediatric	IPD, pneumonia, and AOM	Warren S, Barmpouni M, Kossyvaki V, Gourzoulidis G, Perdrizet J. Estimating the Clinical and Economic Impact of Switching from the 13-Valent Pneumococcal Conjugate Vaccine (PCV13) to Higher-Valent Options in Greek Infants. Vaccines (Basel). 2023 Aug 15;11(8):1369. doi: 10.3390/vaccines11081369

Salo H	2005	Finland	Pediatric	IPD, pneumonia, AOM and PMS	Salo H, Sintonen H, Nuorti JP, Linna M, Nohynek H, Verho J, Kilpi T. Economic evaluation of pneumococcal conjugate vaccination in Finland. Scand J Infect Dis. 2005;37(11-12):821-32. doi: 10.1080/00365540500321512. PMID: 16308215.
Robberstad B	2011	Norway	Pediatric	IPD, pneumonia, AOM and PMS	Robberstad, B., et al., Economic evaluation of second generation pneumococcal conjugate vaccines in Norway. Vaccine, 2011. 29(47): p. 8564-74.
By A	2012	Sweden	Pediatric	IPD, pneumonia, AOM and PMS	By, A., et al., Comparing health outcomes and costs of general vaccination with pneumococcal conjugate vaccines in Sweden: a Markov model. Clinical Therapeutics, 2012. 34(1): p. 177-89.
Talbird SE	2010	Canada, Germany, Mexico and Norway	Pediatric	IPD, pneumonia, AOM and PMS	Talbird SE, Taylor TN, Knoll S, Frostad CR, García Martí S. Outcomes and costs associated with PHiD-CV, a new protein D conjugate pneumococcal vaccine, in four countries. Vaccine. 2010 Nov 19;28 Suppl 6:G23-9. doi: 10.1016/j.vaccine.2010.06.016. PMID: 21075266.
Strutton DR	2012	Germany, Greece and Netherlands	Pediatric	PMS	Strutton, D.R., et al., Cost-effectiveness of 13-valent pneumococcal conjugate vaccine: Germany, Greece, and The Netherlands. Journal of Infection, 2012. 64(1): p. 54-67.
Knerer G	2012	Canada and UK	Pediatric	IPD, pneumonia, AOM and PMS	Knerer, G., A. Ismaila, and D. Pearce, Health and economic impact of PHiD-CV in Canada and the UK: a Markov modelling exercise. Journal of Medical Economics, 2012. 15(1): p. 61-76.
Klok RM	2013	Denmark and Sweden	Pediatric	PMS	Klok, R.M., et al., Cost-effectiveness of a 10- versus 13-valent pneumococcal conjugate vaccine in Denmark and Sweden. Clinical Therapeutics, 2013. 35(2): p. 119-34.
Pugh S	2020	Columbia, Finland and Netherlands	Pediatric	IPD, pneumonia, AOM and PMS	Pugh S, Wasserman M, Moffatt M, Marques S, Reyes JM, Prieto VA, Reijnders D, Rozenbaum MH, Laine J, Åhman H, Farkouh R. Estimating the Impact of Switching from a Lower to Higher Valent Pneumococcal Conjugate Vaccine in Colombia, Finland, and The Netherlands: A Cost-Effectiveness Analysis. Infect Dis Ther. 2020 Jun;9(2):305-324. doi: 10.1007/s40121-020-

00287-5. Epub 2020 Feb 24. PMID: 32096144; PMCID: PMC7237584.

Abbreviations: IPD=Invasive pneumococcal disease; AOM=Acute otitis media; PMS=Post-meningitis sequelae.

Supplementary Table 4. List of included original studies estimating health utility values for pneumococcal disease and PMS in children

First author	Publication year	Country	Age group	Disease	Reference
Kramer, M. S.	1994	Canada	Pediatric	IPD, pneumonia and PMS	Kramer MS, Etezadi-Amoli J, Ciampi A, Tange SM, Drummond KN, Mills EL, Bernstein ML, Leduc DG. Parents' versus physicians' values for clinical outcomes in young febrile children. Pediatrics. 1994 May;93(5):697-702. PMID: 8165064.
Oh PI	1996	Canada	Pediatric	AOM	Oh PI, Maerov P, Pritchard D, Knowles SR, Einarson TR, Shear NH. A cost-utility analysis of second-line antibiotics in the treatment of acute otitis media in children. Clin Ther. 1996 Jan-Feb;18(1):160-82. doi: 10.1016/s0149-2918(96)80188-3. PMID: 8851461.
Stouthard, M. E.	1997	Netherlands	Pediatric and adult	Pneumonia and PMS	Stouthard, M. E., Essink-Bot, M. L., Bonsel, G. J., Barendregt, J., J., K., P. G., Van de Water, H. P., Gunning-Schepers, L. J.,, & & van der Maas, P. J. (1997). *Disability weights for diseases in the Netherlands*. (Inst. Sociale Geneeskunde., Issue.)
Gold MR	1998	US	Pediatric and adult	PMS	Gold MR, Franks P, McCoy KI, Fryback DG. Toward consistency in cost-utility analyses: using national measures to create condition-specific values. Medical Care. 1998; 36(6):778–92.
Bennett JE	2000	US	Pediatric	IPD, pneumonia, and PMS	Bennett JE, Sumner W 2nd, Downs SM, Jaffe DM. Parents' utilities for outcomes of occult bacteremia. Arch Pediatr Adolesc Med. 2000 Jan;154(1):43-8. PMID: 10632249.
IOM	2000	US	Pediatric and adult	IPD, pneumonia, AOM and PMS	Institute of Medicine (US) Committee to Study Priorities for Vaccine Development. Vaccines for the 21st Century: A Tool for Decision making. Stratton KR, Durch JS, Lawrence RS, editors. Washington (DC): National Academies Press (US); 2000. PMID: 25121214.
Cheng AK	2000	US	Pediatric	PMS	Cheng AK, Rubin HR, Powe NR, Mellon NK, Francis HW, Niparko JK. Cost-utility analysis

					of the cochlear implant in children. JAMA 2000; 284:850–6.
Oostenbrink R	2002	Netherlands	Pediatric	PMS	Oostenbrink R, A Moll HA, Essink-Bot ML. The EQ-5D and the Health Utilities Index for permanent sequelae after meningitis: a head-to-head comparison. J Clin Epidemiol. 2002 Aug;55(8):791-9. doi: 10.1016/s0895-4356(02)00448-1. PMID: 12384194.
Koomen I	2003	Netherlands	Pediatric	PMS	Koomen I, Grobbee DE, Jennekens-Schinkel A, Roord JJ, van Furth AM. Parental perception of educational, behavioural and general health problems in school-age survivors of bacterial meningitis. Acta Paediatr. 2003;92(2):177-85. doi: 10.1111/j.1651-2227.2003.tb00523.x. PMID: 12710643.
Prosser LA	2004	US	Pediatric	IPD, pneumonia, and AOM	Prosser LA, Ray GT, O'Brien M, Kleinman K, Santoli J, Lieu TA. Preferences and willingness to pay for health states prevented by pneumococcal conjugate vaccine. Pediatrics. 2004 Feb;113(2):283-90. doi: 10.1542/peds.113.2.283. PMID: 14754939.
Brouwer CN	2005	Netherlands	Pediatric	AOM	Brouwer CN, Maillé AR, Rovers MM, Veenhoven RH, Grobbee DE, Sanders EA, Schilder AG. Effect of pneumococcal vaccination on quality of life in children with recurrent acute otitis media: a randomized, controlled trial. Pediatrics. 2005 Feb;115(2):273-9. doi: 10.1542/peds.2004-0778. PMID: 15687432.
Barton GR	2006	UK	Pediatric	PMS	Barton GR, Stacey PC, Fortnum HM, Summerfield AQ. Hearing-impaired children in the United Kingdom, IV: cost-effectiveness of pediatric cochlear implantation. Ear Hear. 2006 Oct;27(5):575-88. doi: 10.1097/01.aud.0000233967.11072.24.
Petrou S	2009	UK	Pediatric	IPD and PMS	Petrou S, Kupek E. Estimating preference-based health utilities index mark 3 utility scores for childhood conditions in England and Scotland. Med Decis Making. 2009 May-

					Jun;29(3):291-303. doi: 10.1177/0272989X08327398. Epub 2009 Mar 4. PMID: 19264726.
Legood R	2009	UK	Pediatric and adult	PMS	Legood R, Coen PG, Knox K, Viner RM, El Bashir H, Christie D, Patel BC, Booy R. Health related quality of life in survivors of pneumococcal meningitis. Acta Paediatr. 2009 Mar;98(3):543-7. doi: 10.1111/j.1651-2227.2008.01136.x. Epub 2008 Nov 30. PMID: 19046349.
Carroll AE	2009	US	Pediatric	AOM and PMS	Carroll AE, Downs SM. Improving decision analyses: parent preferences (utility values) for pediatric health outcomes. J Pediatr. 2009 Jul;155(1):21-5, 25.e1-5. doi: 10.1016/j.jpeds.2009.01.040. Epub 2009 Apr 24. PMID: 19394030.
Galante J	2011	Argentina, Chile and UK	Pediatric and adult	IPD, pneumonia, AOM and PMS	Galante J, Augustovski F, Colantonio L, Bardach A, Caporale J, Marti SG, Kind P. Estimation and comparison of EQ-5D health states' utility weights for pneumococcal and human papillomavirus diseases in Argentina, Chile, and the United Kingdom. Value Health. 2011 Jul-Aug;14(5 Suppl 1):S60-4. doi: 10.1016/j.jval.2011.05.007. PMID: 21839901.
Kulpeng W	2013	Thailand	Pediatric	IPD, pneumonia, AOM and PMS	Kulpeng W, Sornsrivichai V, Chongsuvivatwong V, Rattanavipapong W, Leelahavarong P, Cairns J, Lubell Y, Teerawattananon Y. Variation of health-related quality of life assessed by caregivers and patients affected by severe childhood infections. BMC Pediatr. 2013 Aug 13;13:122. doi: 10.1186/1471-2431-13-122. PMID: 23941314; PMCID: PMC3751113.
Heidemann CH	2013	Denmark	Pediatric	AOM	Heidemann CH, Godballe C, Kjeldsen AD, Johansen EC, Faber CE, Lauridsen HH. The Otitis Media-6 questionnaire: psychometric properties with emphasis on factor structure and interpretability. Health Qual Life Outcomes. 2013 Nov 20;11:201. doi:

					10.1186/1477-7525-11-201. PMID: 24257471; PMCID: PMC4222717.
Kujala T	2014	Finland	Pediatric	AOM	Kujala T, Alho OP, Kristo A, Uhari M, Renko M, Pokka T, Koivunen P. Quality of life after surgery for recurrent otitis media in a randomized controlled trial. Pediatr Infect Dis J. 2014 Jul;33(7):715-9. doi: 10.1097/INF.0000000000000265. PMID: 24445832.
Al-Janabi H	2016	UK	Pediatric and adult	PMS	Al-Janabi H, Van Exel J, Brouwer W, Trotter C, Glennie L, Hannigan L, Coast J. Measuring Health Spillovers for Economic Evaluation: A Case Study in Meningitis. Health Econ. 2016 Dec;25(12):1529-1544. doi: 10.1002/hec.3259. Epub 2015 Oct 14. PMID: 26464311; PMCID: PMC5111598.
Crawford B	2017	Malaysia	Pediatric	AOM	Crawford B, Hashim SS, Prepageran N, See GB, Meier G, Wada K, Coon C, Delgleize E, DeRosa M. Impact of Pediatric Acute Otitis Media on Child and Parental Quality of Life and Associated Productivity Loss in Malaysia: A Prospective Observational Study. Drugs Real World Outcomes. 2017 Mar;4(1):21-31. doi: 10.1007/s40801-016-0099-9. PMID: 27888477; PMCID: PMC5332310.

Abbreviations: IPD=Invasive pneumococcal disease; AOM=Acute otitis media; PMS=Post-meningitis sequelae.

Detailed findings from the literature review on cost-utility analyses

Invasive pneumococcal disease

Of the 40 CUAs applying a utility input (either utility value or QALY decrement) for IPD (**Supplementary Table 5**), 36 included inputs for both meningitis and non-meningitis IPD, while three included inputs only for non-meningitis IPD, including bacteremia (with or without a focus), invasive pneumonia, and sepsis [1-3]. In addition, three applied utility inputs for IPD without differentiating between meningitis and non-meningitis IPD [4-6]. The inputs for QALY decrements per episode of meningitis ranged from 0.006 to 0.76, with 28 (78%) CUAs using 0.0232 (or 0.023). The QALY decrement input values for non-meningitis IPD ranged from 0.0016 to 0.21, with 30 (77%) CUAs using 0.0079 (or 0.008). Only two studies, both conducted in the Netherlands, applied a utility value instead of a QALY decrement [2, 3]. Additionally, one study in Canada by Lytle et al. (2023) applied the QALY multipliers of 0.997 and 0.996 to meningitis and bacteremia, respectively [7], equivalent to QALY estimates in the source study [8].

The most common input values for meningitis and non-meningitis IPD were sourced from a US study conducted by Bennett et al. (2000) [9], which estimated the utility values of various IPD and PMS conditions using a standard gamble (SG) survey of parents of children receiving emergency care. Three CUAs used utility values from a US study conducted by Prosser et al. (2004) [10], which used a TTO survey of the general population and estimated the highest QALY decrement estimates of any study for meningitis (0.76) and non-meningitis IPD (0.21). Two CUAs, conducted by Prasad et al. (2023) and Lytle et al. (2023) [7, 11], sourced the utility inputs from a pooled analyses conducted by Tang et al. (2022) [8]. Notably, their analyses did not include the study conducted by Bennett et al. (2000) in the QALY estimate for non-meningitis IPD [9]. Other input values were either based on assumptions or extrapolated from other disease states.

Pneumonia

Of the 38 CUAs that included pneumonia (**Supplementary Table 6**), 35 applied separate utility inputs for inpatient and outpatient pneumonia; two applied utility inputs only for inpatient pneumonia [1, 12]; and one applied utility inputs for inpatient pneumonia and pneumonia without specifying the care setting [5]. All but one study applied QALY decrements, which ranged from 0.0060 to 0.59 for an inpatient pneumonia episode and from 0.0004 to 0.18 for an outpatient pneumonia episode. The most common QALY decrement inputs for these two health states were 0.006 and 0.004, respectively, each of which were used in 25 CUAs (68% of CUAs for inpatient pneumonia and 71% of CUAs for outpatient pneumonia). The CUA conducted in Canada by Lytle et al. (2023) applied QALY multipliers (i.e., QALY estimates) [7].

The study by Bennett et al. (2000) [9] was also the most common source for pneumonia utility inputs, and was referenced in 81% and 80% of CUAs for inpatient and outpatient pneumonia, respectively. However, these CUAs applied different QALY decrement estimates for inpatient pneumonia. The majority of the CUAs applied 0.006, derived from the QALY estimate for occult bacteremia with local infection, whereas seven CUAs used 0.008, assuming the same utility for inpatient pneumonia and bacteremia [13-19]. Three CUAs [19-21] derived QALY decrements for pneumonia using the utility values and reported duration of illness from a CUA of pneumococcal vaccine in adults in the US (2000) [22], which did not specify the source for the utility values. Additionally, three CUAs [5, 23, 24] sourced the QALY decrement inputs from the study by Prosser et al. (2004) [10], at 0.59 for inpatient pneumonia and 0.18 for outpatient pneumonia, each representing the largest QALY decrements for these disease states among all CUAs. The pooled analyses by Tang et al. (2022) [8] was referenced for the pneumonia inputs used by Prasad et al. (2023) and Lytle et al. (2023) [7, 11]. Other input values were estimated based on assumptions.

Acute otitis media

Thirty-six CUAs applied utility inputs for various AOM states (**Supplementary Table 7**): 28 applied the inputs to an AOM health state without differentiating disease severity, while eight included both simple AOM and complex/recurrent AOM. In addition, eight studies applied the input for AOM with tympanostomy tube placement, and five included an input for myringotomy. Other less common AOM-related health states included AOM complications and hearing loss. All CUAs applied QALY decrements, except the study conducted by Lytle et al. (2023), which applied a QALY multiplier (i.e., QALY estimate) of 0.998 to both simple and complex AOM [7].

Similar to other pneumococcal disease states, the input values for QALY decrements varied substantially for each health state: AOM (0.0016–0.011), simple AOM (0.005–0.01), complex/recurrent AOM (0.005–0.36), AOM with tympanostomy tube placement (0.0016–0.11), and AOM with myringotomy (0.005). The most common QALY decrement for all AOM health states was 0.005, which was applied in 29 (81%) CUAs. This input was sourced from a Canadian study conducted by Oh et al. (1996) [25], a vignette-based study that estimated the utility of AOM based on VAS responses collected from 10 participating physicians. Two CUAs [23, 24] obtained QALY decrements from the study by Prosser et al. (2004) [10], which estimated the largest QALY decrements for both simple AOM (0.011) and complex AOM (0.36). In contrast, the pooled analyses conducted by Tang et al. (2022) [8] referenced by Prasad et al. (2023) [11] resulted in a QALY decrement of 0.0016, the lowest QALY decrement value for AOM health states used in the CUAs.

Post-meningitis sequelae

Thirty-three studies applied utility inputs for neurological deficits (**Supplementary Table 8**), of which 25 included a single health state of neurological deficits after meningitis and 8 included more than one neurological deficit health state. Twenty-one studies applied utility values and 12 applied QALY decrements. The ranges presented in the CUAs were 0.47–0.89 for utility and 0.10–0.400 for QALY decrement. Converting utility to QALY decrement per year, the range of QALY decrements used in the CUAs was estimated to be 0.10–0.53. The study conducted by Oostenbrink et al. (2002) [26] was the most common source, referenced by 16 CUAs, followed by the study by Morrow et al. (2007) [27], which was referenced by 12 CUAs. Oostenbrink et al. (2002) surveyed 28 physicians in the Netherlands and estimated utilities of various permanent PMS health states using indirect methods based on vignettes and the EQ-5D, health utilities index – Mark 2 (HUI-2), and health utilities index – Mark 3 (HUI-3). Morrow et al. (2007) cited the study by Torrance et al. (1982) [28] for a utility value of 0.6 for neurological sequelae. Other sources for the utility values of neurological deficits included the pooled analyses by Tang et al. (2022) [8] and four original utility studies. Notably, we were unable to identify or derive the majority of the utility values of neurological deficits from the source studies cited by the CUAs.

Among 38 studies that applied a utility input for hearing loss, 26 included a single health state of hearing loss and 12 included two or more hearing loss-related health states. Slightly more CUAs applied utility values (n=21) than QALY decrements (n=17). The ranges, as presented in the original CUA studies, were 0.45─0.91 for utilities and 0.054─0.460 for QALY decrements. Converting utility to QALY decrement per year, the range of QALY decrements used in the 34 CUAs was 0.054─0.55. The studies by Oostenbrink et al. (2002) [26] and Morrow et al. (2007) [27] were also the most frequently referenced sources of utilities for hearing loss, by 12 and 11 CUAs, respectively. Utility values of 0.81 for deafness and 0.91 for mild hearing loss were referenced from the study by Oostenbrink et al. (2002) [26], while a utility value of 0.8 (or a QALY decrement of 0.2) was cited from the study by Morrow et al. (2007) [27]. Additionally, the study conducted by Erickson et al. (2001) [29] was referenced by 10 CUAs, including seven CUAs conducted in the US, despite the utility for hearing loss in that study being based on the EQ-5D response from a single adult. Another common source of utilities for hearing loss was a meta-analysis of health utility for profound deafness in adults [30], which was referenced by seven CUAs. Four CUAs applied utility inputs for other PMS health states, but these health states were not commonly included in CUAs of pneumococcal vaccines.

Supplementary Table 5: Health utility inputs for IPD per episode in the pediatric CUAs of pneumococcal vaccines in the US, Canada, and Europe

Author and year	Country	Age group	Health state	Type of utility input	Base-case value	Reference	Source study
Meningitis							
Ray GT 2006	US	0-5	Meningitis complex otitis	QALY decrements	0.76	Prosser LA 2004	Prosser LA 2004
O'Brien MA 2009	US	0-4	Meningitis	QALY decrements	0.76	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010a	US	All ages	Meningitis	QALY decrements	0.0232	Melegaro A 2004	Bennett JE 2000
Rubin JL 2010b	US	All ages	Meningitis	QALY decrements	0.023	Melegaro A 2004	Bennett JE 2000
Stoecker C 2013	US	0-10	Meningitis	QALY decrements	0.0232	Rubin JL 2010a	Bennett JE 2000
McGarry LJ 2013	US	All ages	Meningitis	QALY decrements	0.0232	Rubin JL 2010b	Bennett JE 2000
Huang M 2023	US	0-18	Meningitis	QALY decrements	0.023	Rubin JL 2010a	Bennett JE 2000
Prasad N 2023[1]	US	0-15	Meningitis	QALY decrements	0.0165	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Bennett JE 2000; Prosser LA 2004
Rozenbaum MH 2024b	US	0-17	Meningitis	QALY decrements	0.0232	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Rozenbaum MH 2024c	US	0-17	Meningitis	QALY decrements	0.023	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Poirier B 2009[2]	Canada	All ages	Pneumococcal meningitis	QALY decrements	0.200	Melegaro A 2004	Cheng AK 1999
De Wals P 2009	Canada	All ages	Meningitis	QALY decrements	0.0232	Melegaro A 2004	Bennett JE 2000
Chuck AW 2010	Canada	All ages	Meningitis	QALY decrements	0.0232	Morrow A 2007; Melegaro A 2004	Bennett JE 2000
Wilson M 2018	Canada	All ages	Meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Lytle D 2023[3]	Canada	0-17	Meningitis	QALY multiplier	0.997	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Bennett JE 2000; Prosser LA 2004
Melegaro A 2004	UK	All ages	Meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Van Hoek AJ 2012	UK	All ages	Meningitis	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
Rozenbaum MH 2012	UK	>=2	Meningitis	QALY decrements	0.023	Rozenbaum MH 2010; Bennett JE 2000	Bennett JE 2000
Delgleize E 2016	UK	All ages	Meningitis (hospitalized)	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
Wilson M 2023[4]	UK	All ages	Meningitis	QALY decrements	0.13	Mangen MJ 2017	Mangen MJ 2017
Claes C 2009	Germany	All ages	Meningitis	QALY decrements	0.76	Prosser LA 2004	Prosser LA2004
Kuhlmann A 2017	Germany	All ages	Meningitis	QALY decrements	0.0232	Melegaro A 2004	Bennett JE 2000

Ta A 2024	Germany	0-17	Meningitis	QALY decrements	0.023	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Castiglia P 2017	Italy	0-18	Meningitis (inpatient)	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
Ansaldi F 2020	Italy	All ages	Meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Diez-Domingo J 2011	Spain	All ages	Meningitis	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
Rozenbaum MH 2010a	Netherlands	0-5	Hospitalized meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Rozenbaum MH 2010b	Netherlands	All ages	Meningitis	QALY decrements	0.0232	Melegaro A 2004	Bennett JE 2000
Blank PR 2012	Switzerland	All ages	Meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Warren S 2023	Greece	All ages	Meningitis	QALY decrements	0.0232	Melegaro A 2004; Bennet JE 2000	Bennett JE 2000
Salo H 2005[5]	Finland	0-5	Meningitis	QALY decrements	0.006	Vold Pepper P 2000	Vold Pepper P 2000
Robberstad B 2011	Norway	All ages	Meningitis	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
By A 2012	Sweden	All ages	Meningitis	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
Talbird SE 2010	Canada, Germany, Mexico and Norway	All ages	Meningitis - inpatient	QALY decrements	0.023	Bennett JE 2000	Bennett JE 2000
Knerer G 2012	Canada and UK	All ages	Inpatient meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Pugh S 2020	Columbia, Finland and Netherlands	All ages	Meningitis	QALY decrements	0.0232	Bennett JE 2000	Bennett JE 2000
Non-meningitis IPD							
Ray GT 2006	US	0-5	Bacteremia	QALY decrements	0.21	Prosser LA 2004	Prosser LA 2004
O'Brien MA 2009	US	0-4	Bacteremia	QALY decrements	0.21	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010a	US	All ages	Bacteremia	QALY decrements	0.0079	Melegaro 2004	Bennett JE 2000
Rubin JL 2010b	US	All ages	Bacteremic pneumonia	QALY decrements	0.008	Melegaro 2004	Bennett JE 2000
Stoecker C 2013	US	0-10	Non-meningitis IPD	QALY decrements	0.0079	Rubin JL 2010a	Bennett JE 2000
McGarry LJ 2013	US	All ages	Bacteremia	QALY decrements	0.008	Rubin JL 2010b	Bennett JE 2000
Huang M 2023	US	0-18	Bacteremia	QALY decrements	0.008	Rubin JL 2010a	Bennett JE 2000
Prasad N 2023[1]	US	0-15	Bacteremia	QALY decrements	0.0016	Tang Z 2022	Kulpeng W 2013; Prosser LA 2004
Rozenbaum MH 2024b	US	0-17	Bacteremia	QALY decrements	0.0079	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Rozenbaum MH 2024c	US	0-17	Bacteremia	QALY decrements	0.008	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000

Poirier B 2009	Canada	All ages	Hospitalized and non-hospitalized pneumococcal bacteremia	QALY decrements	0.008	Melegaro A 2004	Bennett JE 2000
De Wals P 2009	Canada	All ages	Bacteremia	QALY decrements	0.0079	Melegaro A 2004	Bennett JE 2000
Chuck AW 2010	Canada	All ages	Bacteremia	QALY decrements	0.0079	Morrow A 2007; Melegaro A 2004	Bennett JE 2000
Wilson M 2018	Canada	All ages	Bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Lytle D 2023[3]	Canada	0-17	Bacteremia	QALY multiplier	0.996	Tang Z 2022	Kulpeng W 2013; Prosser LA 2004
Melegaro A 2004	UK	All ages	Bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Van Hoek AJ 2012	UK	All ages	Hospitalization for pneumococcal bacteremia or pneumonia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Rozenbaum MH 2012	UK	>=2	Bacteremia (invasive pneumonia, bacteremia with focus, and bacteremia without focus)	QALY decrements	0.0079	Rozenbaum MH 2010; Bennett JE 2000	Bennett JE 2000
Delgleize E 2016	UK	All ages	Bacteremia (hospitalized) Bacteremia (outpatient)	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Wilson M 2023[4]	UK	All ages	Bacteremia	QALY decrements	0.13	Mangen MJ 2017	Mangen MJ 2017
Claes C 2009	Germany	All ages	Sepsis	QALY decrements	0.21	Prosser LA 2004	Prosser LA 2004
Kuhlmann A 2017	Germany	All ages	Non-meningitis IPD	QALY decrements	0.0079	Melegaro A 2004	Bennett JE 2000
Ta A 2024	Germany	0-17	Bacteremia	QALY decrements	0.008	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Castiglia P 2017	Italy	0-18	Bacteremia (inpatient)	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
			Bacteremia (outpatient)	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Ansaldi F 2020	Italy	All ages	Bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000

Diez-Domingo J 2011	Spain	All ages	Bacteremia	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Beutels P 2011	Belgium	All ages	Bacteremia	QALY decrements	0.0079	Melegaro A 2004	Bennett JE 2000
Hubben GA 2007	Netherlands	All ages	Invasive pneumonia	Utility	0.90	Stouthard ME 1997	Stouthard ME 1997
Bos JM 2003	Netherlands	All ages	Invasive pneumonia	Utility	0.90	Stouthard ME 1997	Stouthard ME 1997
Rozenbaum MH 2010a	Netherlands	0-5	Hospitalized bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Rozenbaum MH 2010b	Netherlands	All ages	Bacteremia	QALY decrements	0.0079	Melegaro A 2004	Bennett JE 2000
Blank PR 2012	Switzerland	All ages	Bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Warren S 2023	Greece	All ages	Bacteremia	QALY decrements	0.0079	Melegaro A 2004; Bennet JE 2000	Bennett JE 2000
Salo H 2005[5]	Finland	0-5	Bacteremia	QALY decrements	0.006	Vold Pepper P 2000	Vold Pepper P 2000
Robberstad B 2011	Norway	All ages	Bacteremia	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
By A 2012	Sweden	All ages	Bacteremia	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Talbird SE 2010	Canada, Germany, Mexico and Norway	All ages	Bacteremia - inpatient	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Knerer G 2012	Canada and UK	All ages	Inpatient bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Pugh S 2020[6]	Columbia, Finland and Netherlands	All ages	Bacteremia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
IPD (overall)							
Ray GT 2006[7]	US	5-15	IPD	QALY decrements	0.007	Erickson P 1995 Unpublished LOS data from Kaiser Permanente	Erickson P 1995 Unpublished LOS data from Kaiser Permanente
Rozenbaum MH 2024a[8]	US	6-15	IPD	QALY decrements	0.009	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Kuhlmann A 2017[9]	Germany	All ages	IPD	QALY decrements	0.0079	Assumptions	Bennett JE 2000

Abbreviations: IPD=Invasive pneumococcal disease; CUA=Cost-utility analysis; US=United States; QALY=Quality-adjusted life year; UK=United Kingdom; LOS=Length of stay.

Notes:

1. Prasad N (2023) used the inverse variance weighted average of QALY estimates from the meta-analysis conducted by Tang Z et al. (2022) as the base-case input.
2. The QALY decrement input used in this study was derived based on the utility of bilateral hearing loss after meningitis subsequent years, which was normally used as a utilty input for post-meningitis sequelae in the CUAs. This could be a typo as the referenced study (Melegaro A et al., 2004) used 0.0232 as the QALY decrement for meningitis.
3. Although the study labeled the input as "QALY multiplier", the value was obtained from the median estimated QALYs, and thus interpreted as QALY estimates.
4. The QALY decrement input used in this study was obtained from a study estimating health utility for inpatient pneumonia among patients aged ≥65 years in the Netherlands.
5. The QALY decrement value for meningitis was assumed to be the same as that for inpatient pneumonia.
6. The study used the value "0.0070", which appeared to be a typo because all CUAs referenced Bennett JE (2000) used "0.0079/0.008". Therefore, the correct value was used in the table.
7. The referenced study Erickson P (1995) was based on assumption instead of empirical data. The utility was not estimated for IPD but was used by this CUA as the utility for IPD.
8. The QALY decrement input used in this study was estimated as a weighted average of QALY decrements of meningitis (0.0232) and bacteremia (0.0079), where the weights were 7% for meningitis and 93% for bacteremia based on the data from the US Centers for Disease Control and Prevention Active Bacterial Core Surveillance report.
Centers for Disease Control and Prevention. Active Bacterial Core Surveillance Report, Emerging Infections Program Network, Streptococcus pneumoniae, 2019.
9. The value was the same as the most commonly used input for non-meningitis IPD.

Supplementary Table 6: Health utility inputs for pneumonia per episode in the pediatric CUAs of pneumococcal vaccines in the US, Canada, and Europe

Author and year	Country	Age group	Health state	Type of utility input	Base-case value	Reference	Source study
Inpatient pneumonia							
Ray GT 2006[1]	US	5-15	Hospitalized pneumonia	QALY decrements	0.007	Erickson P 1995 Unpublished LOS data from Kaiser Permanente	Erickson P 1995 Unpublished LOS data from Kaiser Permanente
Ray GT 2006[1]	US	15-45	Hospitalized pneumonia	QALY decrements	0.009	Erickson P 1995 Unpublished LOS data from Kaiser Permanente	Erickson P 1995 Unpublished LOS data from Kaiser Permanente
O'Brien MA 2009	US	0-4	Complicated pneumonia	QALY decrements	0.59	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010a	US	All ages	Inpatient pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Rubin JL 2010b	US	All ages	Inpatient pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Stoecker C 2013	US	0-10	Inpatient pneumonia	QALY decrements	0.006	Rubin JL 2010a	Bennett JE 2000
McGarry LJ 2013	US	All ages	Inpatient pneumonia	QALY decrements	0.006	Rubin JL 2010b	Bennett JE 2000
Huang M 2023	US	0-18	Inpatient pneumonia	QALY decrements	0.006	Rubin JL 2010a	Bennett JE 2000
Prasad N 2023[2]	US	0-15	Inpatient pneumonia	QALY decrements	0.0105	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Bennett JE 2000; Prosser LA 2004
Rozenbaum MH 2024a	US	6-15	All-cause NBP, inpatient	QALY decrements	0.006	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Rozenbaum MH 2024b	US	0-17	All-cause hospitalized pneumonia	QALY decrements	0.006	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Rozenbaum MH 2024c	US	0-17	Hospitalized pneumonia	QALY decrements	0.006	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Poirier B 2009[3]	Canada	All ages	Hospitalized all-cause pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
De Wals P 2009	Canada	All ages	Inpatient pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Chuck AW 2010	Canada	All ages	Hospitalized pneumonia	QALY decrements	0.006	Morrow A 2007; Melegaro A 2004	Bennett JE 2000
Wilson M 2018	Canada	All ages	Hospitalized pneumonia	QALY decrements	0.0060	Melegaro A 2004	Bennett JE 2000
Lytle D 2023[4]	Canada	0-17	Hospitalized pneumonia	QALY multiplier	0.984	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Bennett JE 2000; Prosser LA 2004
Melegaro A 2004	UK	All ages	Inpatient pneumonia	QALY decrements	0.006	Bennett JE 2000	Bennett JE 2000

Van Hoek AJ 2012[5]	UK	All ages	Hospitalization for pneumococcal bacteremia or pneumonia	QALY decrements	0.0079	Bennett JE 2000	Bennett JE 2000
Rozenbaum MH 2012	UK	≥2	Non-bacteremic pneumococcal pneumonia	QALY decrements	0.006	Rozenbaum MH 2010; Bennett JE 2000	Bennett JE 2000
Delgleize E 2016[5]	UK	All ages	Pneumonia (hospitalized)	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Wilson M 2023[6]	UK	All ages	Hospitalized pneumonia	QALY decrements	0.13	Mangen MJ 2017	Mangen MJ 2017
Claes C 2009[7]	Germany	0-<5	Pneumonia inpatient	QALY decrements	0.59	Prosser LA 2004	Prosser LA 2004
Claes C 2009	Germany	5-<55	Pneumonia inpatient	QALY decrements	0.01	Assumption	Assumption
Kuhlmann A 2017	Germany	All ages	Pneumonia (hospitalized)	QALY decrements	0.0060	Melegaro A 2004	Bennett JE 2000
Ta A 2024	Germany	0-17	Hospitalized pneumonia	QALY decrements	0.006	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000
Castiglia P 2017[5]	Italy	0-18	Pneumonia (inpatient)	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Ansaldi F 2020	Italy	All ages	Inpatient pneumonia	QALY decrements	0.0060	Melegaro A 2004	Bennett JE 2000
Diez-Domingo J 2011	Spain	All ages	Hospital admitted pneumonia	QALY decrements	0.006	Bennett JE 2000	Bennett JE 2000
Beutels P 2011	Belgium	All ages	Pneumonia inpatient	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Rozenbaum MH 2010a	Netherlands	0-5	Hospitalized non-invasive pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Rozenbaum MH 2010b	Netherlands	All ages	Inpatient pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Blank PR 2012	Switzerland	All ages	Complex pneumonia	QALY decrements	0.006	Vold Pepper P 2000	Vold Pepper P 2000
Warren S 2023	Greece	All ages	Inpatient CAP	QALY decrements	0.006	Melegaro A 2004; Bennet JE 2000	Bennett JE 2000
Salo H 2005	Finland	0-5	Pneumonia inpatient	QALY decrements	0.006	Vold Pepper P 2000	Vold Pepper P 2000
Robberstad B 2011[5]	Norway	All ages	Hospitalized pneumonia	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
By A 2012[5]	Sweden	All ages	Hospitalized pneumonia	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
Talbird SE 2010[5]	Canada, Germany, Mexico and Norway	All ages	Inpatient pneumonia	QALY decrements	0.008	Assumption	Bennett JE 2000
Knerer G 2012[5]	Canada and UK	All ages	Inpatient pneumonia	QALY decrements	0.0079	Assumption	Bennett JE 2000
Pugh S 2020[8]	Columbia, Finland and Netherlands	All ages	Inpatient pneumonia	QALY decrements	0.006	Melegaro A 2004	Bennett JE 2000
Outpatient pneumonia							
O'Brien MA 2009	US	0-4	Outpatient pneumonia	QALY decrements	0.18	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010a	US	All ages	Outpatient pneumonia	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Rubin JL 2010b	US	All ages	Outpatient pneumonia	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Stoecker C 2013	US	0-10	Outpatient pneumonia	QALY decrements	0.004	Rubin JL 2010a	Bennett JE 2000; Vold Pepper P 2000[9]

McGarry LJ 2013	US	All ages	Outpatient pneumonia	QALY decrements	0.004	Rubin JL 2010b	Bennett JE 2000; Vold Pepper P 2000[9]
Huang M 2023	US	0-18	Outpatient pneumonia	QALY decrements	0.004	Rubin JL 2010a	Bennett JE 2000; Vold Pepper P 2000[9]
Prasad N 2023[2]	US	0-15	Outpatient pneumonia	QALY decrements	0.0004	Tang Z 2022	Kulpeng W 2013; Prosser LA 2004
Rozenbaum MH 2024a	US	6-15	All-cause NBP, outpatient	QALY decrements	0.004	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000; Vold Pepper P 2000[9]
Rozenbaum MH 2024b	US	0-17	All-cause non-hospitalized pneumonia	QALY decrements	0.004	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000; Vold Pepper P 2000[9]
Rozenbaum MH 2024c	US	0-17	Non-hospitalized pneumonia	QALY decrements	0.004	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000; Vold Pepper P 2000[9]
Poirier B 2009[3]	Canada	All ages	Non-hospitalized all-cause pneumonia	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
De Wals P 2009	Canada	All ages	Outpatient pneumonia	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Chuck AW 2010	Canada	All ages	Non-hospitalized pneumonia	QALY decrements	0.004	Morrow A 2007; Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Wilson M 2018	Canada	All ages	Non-hospitalized pneumonia	QALY decrements	0.0040	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Lytle D 2023[10]	Canada	0-17	Non-hospitalized pneumonia	QALY multiplier	0.998	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Bennett JE 2000; Prosser LA 2004
Melegaro A 2004	UK	All ages	Outpatient pneumonia	QALY decrements	0.004	Bennett JE 2000; Vold Pepper P 2000	Bennett JE 2000; Vold Pepper P 2000[9]
Van Hoek AJ 2012	UK	All ages	Pneumonia outpatient visit	QALY decrements	0.0037	Vold Pepper P 2000	Vold Pepper P 2000
Delgleize E 2016	UK	All ages	Pneumonia (outpatient)	QALY decrements	0.006	Bennett JE 2000	Bennett JE 2000
Claes C 2009	Germany	All ages	Pneumonia outpatient	QALY decrements	0.01	Assumption	Assumption
Kuhlmann A 2017	Germany	All ages	Pneumonia (outpatient)	QALY decrements	0.0040	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Ta A 2024	Germany	0-17	Non-hospitalized pneumonia	QALY decrements	0.004	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Bennett JE 2000; Vold Pepper P 2000[9]
Castiglia P 2017	Italy	0-18	Pneumonia (outpatient)	QALY decrements	0.006	Bennett JE 2000	Bennett JE 2000
Ansaldi F 2020	Italy	All ages	Outpatient pneumonia	QALY decrements	0.0040	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]

Diez-Domingo J 2011	Spain	All ages	Pneumonia treated in the community	QALY decrements	0.004	Bennett JE 2000	Bennett JE 2000
Beutels P 2011	Belgium	All ages	Pneumonia outpatient	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000
Rozenbaum MH 2010a	Netherlands	0-5	Non-invasive pneumonia treated at the GP	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Rozenbaum MH 2010b	Netherlands	All ages	Outpatient pneumonia	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Blank PR 2012	Switzerland	All ages	Simple pneumonia	QALY decrements	0.004	Vold Pepper P 2000	Vold Pepper P 2000
Warren S 2023	Greece	All ages	Outpatient CAP	QALY decrements	0.004	Melegaro A 2004; Bennet JE 2000	Bennett JE 2000; Vold Pepper P 2000[9]
Salo H 2005	Finland	0-5	Pneumonia outpatient visit	QALY decrements	0.004	Vold Pepper P 2000	Vold Pepper P 2000
Robberstad B 2011[11]	Norway	All ages	Non-hospitalized pneumonia	QALY decrements	0.008	Bennett JE 2000	Bennett JE 2000
By A 2012	Sweden	All ages	Ambulatory pneumonia	QALY decrements	0.006	Bennett JE 2000	Bennett JE 2000
Talbird SE 2010	Canada, Germany, Mexico and Norway	All ages	Outpatient pneumonia	QALY decrements	0.006	Bennett JE 2000	Bennett JE 2000
Knerer G 2012	Canada and UK	All ages	Outpatient pneumonia	QALY decrements	0.0059	Bennett JE 2000	Bennett JE 2000
Pugh S 2020[8]	Columbia, Finland and Netherlands	All ages	Outpatient pneumonia	QALY decrements	0.004	Melegaro A 2004	Bennett JE 2000; Vold Pepper P 2000[9]
Pneumonia (overall)							
Ray GT 2006	US	0-5	Pneumonia	QALY decrements	0.19	Prosser LA 2004	Prosser LA 2004

Abbreviations: CUA=Cost-utility analysis; US=United States; QALY=Quality-adjusted life year; LOS=Length of stay; NBP=Non-bacteremic pneumonia; UK=United Kingdom; CAP=Community-acquired pneumonia; GP=General practitioner.

Notes:

1. The referenced study Erickson P (1995) was based on assumption instead of empirical data. The utility was not estimated for IPD but was used by this CUA as the utility for IPD.
2. Prasad N (2023) used the inverse variance weighted average of QALY estimates from the meta-analysis conducted by Tang Z et al. (2022) as the base-case input.
3. In the original publication, the references for inpatient and outpatient pneumonia were switched. The correct ones were used in this table.
4. Although the study labeled the input as "QALY multiplier", the value was obtained from estimated QALYs in the reference, and thus interpreted as QALY estimates. However, different from the input values for meningitis and bacteremia, the authors used the low estimated QALYs for inpatient pneumonia instead of the median in the study conducted by Tang Z et al. (2022).
5. The QALY decrement value for inpatient pneumonia was assumed to be the same as that for hospitalized bacteremia.
6. The QALY decrement input used in this study was obtained from a study estimating health utility for inpatient pneumonia among patients aged ≥65 years in the Netherlands.
7. The study used the value "0.19", which appeared to be a typo because Prosser LA (2000) estimated "0.59" for severe pneumonia involving hospitalization. Therefore, the correct value was used in the table.
8. The study made typos by switching the inputs for inpatient and outpatient pneumonia, resulting a higher QALY decrement for outpatient pneumonia. The correct values were used in the table.
9. The ratio of the utility values between inpatient and outpatient pneumonia from Vold Pepper P (2000) was applied to the QALY decrement of inpatient pneumonia from the study by Bennett JE (2000) to derive the QALY decrement for outpatient pneumonia.
10. Although the study labeled the input as "QALY multiplier", the value was obtained from estimated QALYs in the reference, and thus interpreted as QALY estimates. However, the input value for non-hospitalized pneumonia was obtained from the median estimated QALYs for inpatient pneumonia in the study conducted by Tang Z et al. (2022). The median estimated QALY for non-inpatient pneumonia from that study was 0.983.
11. The study used the same value for bacteremia, inpatient pneumonia and outpatient pneumonia.

Supplementary Table 7: Health utility inputs for AOM per episode in the pediatric CUAs of pneumococcal vaccines in the US, Canada, and Europe

Author and year	Country	Age group	Health state	Type of utility input	Base-case value	Reference	Source study
AOM							
O'Brien MA 2009	US	0-4	AOM	QALY decrements	0.011	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010b	US	All ages	AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Stoecker C 2013	US	0-10	OM	QALY decrements	0.005	Rubin JL 2010	Oh PI 1996
Prasad N 2023[1]	US	0-15	AOM	QALY decrements	0.0016	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Oh PI 1996; Prosser LA 2004; Petrou S 2010
Rozenbaum MH 2024a	US	6-15	OM	QALY decrements	0.005	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Oh PI 1996
Rozenbaum MH 2024b	US	0-17	OM	QALY decrements	0.005	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Oh PI 1996
Rozenbaum MH 2024c	US	0-17	OM	QALY decrements	0.005	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Oh PI 1996
Poirier B 2009	Canada	0-18	Visits for all-cause otitis media	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
De Wals P 2009	Canada	All ages	AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Chuck AW 2010	Canada	All ages	OM	QALY decrements	0.005	Morrow A 2007; Melegaro A 2004	Oh PI 1996
Wilson M 2018	Canada	All ages	AOM	QALY decrements	0.0050	Melegaro A 2004	Oh PI 1996
Melegaro A 2004	UK	All ages	OM	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Van Hoek AJ 2012	UK	All ages	OM	QALY decrements	0.0035	Petrou S 2010	Petrou S 2010
Delgleize E 2016	UK	All ages	AOM (outpatient)	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Wilson M 2023	UK	All ages	OM	QALY decrements	0.0035	Van Hoek AJ 2012	Petrou S 2010
Kuhlmann A 2017	Germany	All ages	AOM	QALY decrements	0.0050	Melegaro A 2004	Oh PI 1996
Ta A 2024	Germany	0-17	OM	QALY decrements	0.005	Stoecker C 2013; Melegaro A 2004; Rozenbaum MH 2012	Oh PI 1996
Castiglia P 2017	Italy	0-18	AOM (outpatient)	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Ansaldi F 2020[2]	Italy	All ages	AOM	QALY decrements	0.0050	Melegaro A 2004; Cheng AK 1999	Oh PI 1996
Beutels P 2011	Belgium	All ages	AOM	QALY decrements	0.005	Melegaro A 2004	Bennett JE 2000
Blank PR 2012	Switzerland	All ages	OM	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Warren S 2023	Greece	All ages	Mild OM	QALY decrements	0.005	Melegaro A 2004; Oh PI 1996	Oh PI 1996
Salo H 2005	Finland	0-5	AOM	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Robberstad B 2011	Norway	All ages	AOM, not-hospitalized	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
By A 2012	Sweden	All ages	GP visits due to AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996

Talbird SE 2010	Canada, Germany, Mexico and Norway	All ages	AOM (outpatient)	QALY decrements	0.005	Oh PI 1996; Melegaro A 2004	Oh PI 1996
Knerer G 2012	Canada and UK	All ages	AOM (outpatient)	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Pugh S 2020[2]	Columbia, Finland and Netherlands	All ages	OM	QALY decrements	0.0050	Melegaro A 2004; Cheng AK 1999	Oh PI 1996
Simple AOM							
Ray GT 2006	US	0-5	Simple otitis	QALY decrements	0.01	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010a	US	All ages	AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Huang M 2023	US	0-18	AOM	QALY decrements	0.005	Rubin JL 2010	Oh PI 1996
Lytle D 2023[3]	Canada	0-5	Simple OM	QALY multiplier	0.998	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Oh PI 1996; Prosser LA 2004; Petrou S 2010
Claes C 2009[4]	Germany	0-10	OM, outpatient	QALY decrements	0.01	Assumption	Assumption
Diez-Domingo J 2011	Spain	All ages	Simple AOM	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Rozenbaum MH 2010a	Netherlands	0-5	Simple AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Rozenbaum MH 2010b	Netherlands	All ages	Simple OM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Complex/recurrent AOM							
Ray GT 2006	US	0-5	complex otitis	QALY decrements	0.36	Prosser LA 2004	Prosser LA 2004
Rubin JL 2010a	US	All ages	AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Huang M 2023	US	0-18	AOM	QALY decrements	0.005	Rubin JL 2010	Oh PI 1996
Lytle D 2023[3]	Canada	0-5	Complex OM	QALY multiplier	0.998	Tang Z 2022	Carroll A 2009; Kulpeng W 2013; Oh PI 1996; Prosser LA 2004; Petrou S 2010
Claes C 2009	Germany	0-10	OM, inpatient	QALY decrements	0.36	Prosser LA 2004	Prosser LA 2004
Diez-Domingo J 2011	Spain	All ages	Complex AOM	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Rozenbaum MH 2010a	Netherlands	0-5	Complex AOM without tympanostomy	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Rozenbaum MH 2010b	Netherlands	All ages	Complicated OM without tympanostomy	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
AOM tympanostomy tube placement							
O'Brien MA 2009[5]	US	0-4	tympanostomy tube insertion	QALY decrements	0.11	Prosser LA 2004; Bergus GR 1998	Prosser LA 2004; Bergus GR 1998
Stoecker C 2013	US	0-10	tympanostomy tube placement	QALY decrements	0.005	Rubin JL 2010	Oh PI 1996
Huang M 2023	US	0-18	Tube placement	QALY decrements	0.005	Rubin JL 2010	Oh PI 1996
Prasad N 2023[1,6]	US	0-15	tympanostomy tube insertion	QALY decrements	0.0016	Tang Z 2022; Delgleize E 2016	Carroll A 2009; Kulpeng W 2013; Oh PI 1996; Prosser LA 2004; Petrou S 2010
Poirier B 2009	Canada	0-18	Myringotomy with ventilation tube insertion	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996

Delgleize E 2016[7]	UK	All ages	AOM hospitalized myringotomy/tympanostomy tube placement procedures	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Castiglia P 2017[7]	Italy	0-18	AOM/TTP hospitalized	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
By A 2012[7]	Sweden	All ages	Tube insertions due to AOM	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
AOM myringotomy							
Knerer G 2012[7]	Canada and UK	All ages	Hospitalized myringotomy	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Rozenbaum MH 2010a	Netherlands	0-5	Complex AOM with tympanostomy	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Rozenbaum MH 2010b	Netherlands	All ages	Complicated OM with tympanostomy	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996
Salo H 2005[7]	Finland	0-5	Tympanostomy and/or adenectomy	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Robberstad B 2011[7]	Norway	All ages	AOM, hospitalized (myringotomy)	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Others							
Claes C 2009[4]	Germany	0-10	OM, outpatient paracentesis	QALY decrements	0.01	Assumption	Assumption
Castiglia P 2017[7]	Italy	0-18	AOM complications	QALY decrements	0.005	Oh PI 1996	Oh PI 1996
Castiglia P 2017	Italy	0-18	Hearing loss from AOM	QALY decrements	0.090	Oostenbrink R 2002	Oostenbrink R 2002
Castiglia P 2017	Italy	0-18	Long-term AOM sequelae	QALY decrements	0.090	Oostenbrink R 2002	Oostenbrink R 2002
Robberstad B 2011	Norway	All ages	Hearing loss from AOM (per year)	QALY decrements	0.090	Oostenbrink R 2002	Oostenbrink R 2002
By A 2012[7]	Sweden	All ages	Mastoiditis	QALY decrements	0.005	Melegaro A 2004	Oh PI 1996

Abbreviations: AOM=Acute otitis media; CUA=Cost-utility analysis; US=United States; QALY=Quality-adjusted life year; OM=Otitis media; UK=United Kingdom; GP=General practitioner; TTP=Tympanostomy tube placement.

Notes:

1. Prasad N (2023) used the inverse variance weighted average of QALY estimates from the meta-analysis conducted by Tang Z et al. (2022) as the base-case input.
2. Although the study referenced Cheng AK (1999), the QALY decrement value was from Melegaro A (2004) only, which was sourced to Oh PI (1996), the most commonly used source study for AOM health states.
3. Although the study labeled the input as "QALY multiplier", the value was obtained from the median estimated QALYs for AOM in the reference, and thus interpreted as QALY estimates.
4. The CUA did not provide a reference for the input. However, based on the input for OM, inpatient, from the same CUA, the source should be Prosser LA (2004), simple AOM.
5. The QALY decrement was estimated using the value for simple AOM from Prosser LA (2004), 0.011, multiplied by 10, which was obtained from the study by Bergus GR (1998) that reported a trade-off ratio between an episode of OM and an episode of tube placement as 10.
6. The QALY decrement value was from Tang Z (2022). The assumption that AOM tube placement had the same QALY decrement as AOM was based on the CUA by Delgleize E (2016).
7. The QALY decrement value was assumed to be the same as AOM (outpatient).

Supplementary Table 8: Health utility inputs for PMS in the pediatric CUAs of pneumococcal vaccines in the US, Canada, and Europe

Author and year	Country	Age group	Health state	Type of utility input	Base-case value	Reference	Source study
Neurological deficits							
Rubin JL 2010a	US	All ages	Disability	Utility	0.68	Oostenbrink R 2002	Oostenbrink R 2002
Rubin JL 2010b	US	All ages	Disability	Utility	0.68	Oostenbrink R 2002	Oostenbrink R 2002
Stoecker C 2013	US	0-10	Disability	Utility	0.68	Rubin LJ 2010	Oostenbrink R 2002
McGarry LJ 2013	US	All ages	Disability	Utility	0.68	Rubin LJ 2010	Oostenbrink R 2002
Huang M 2023	US	All ages	Neurological deficits	Utility	0.68	Rubin LJ 2010	Oostenbrink R 2002
Prasad N 2023[1]	US	All ages	Disability	QALY decrements	0.2456	Tang Z 2022	Carroll A 2009; Kulpeng W 2013
Rozenbaum MH 2024b	US	All ages	Disability	Utility	0.680	Rubin LJ 2010; Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2024c	US	All ages	Disability	Utility	0.680	Rubin LJ 2010; Oostenbrink R 2002	Oostenbrink R 2002
Chuck AW 2010	Canada	All ages	Neurologic impairment	QALY decrements	0.40	Morrow A 2007	Torrance G 1982[2]
Earnshaw SR 2012	Canada	All ages	Neurologic impairment	Utility	0.6	Morrow A 2007	Torrance G 1982[2]
Wilson M 2018	Canada	All ages	Neurologic impairment	QALY decrements	0.40	Morrow A 2007	Torrance G 1982[2]
Lytle D 2023	Canada	All ages	Disability	Utility	0.680	Oostenbrink R 2002	Oostenbrink R 2002
Van Hoek AJ 2012	UK	All ages	Epilepsy	Utility	0.83	Oostenbrink R 2002	Oostenbrink R 2002
Van Hoek AJ 2012	UK	All ages	Mild mental retardation	Utility	0.62	Oostenbrink R 2002	Oostenbrink R 2002
Van Hoek AJ 2012	UK	All ages	Paresis	Utility	0.67	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2012	UK	>=2	Seizures	Utility	0.83	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2012	UK	>=2	Hydrocephalus	Utility	0.62	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2012	UK	>=2	Spasticity or paresis	Utility	0.67	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2012	UK	>=2	Cranial nerve palsy	Utility	0.67	Oostenbrink R 2002	Oostenbrink R 2002
Delgleize E 2016	UK	All ages	Neurological sequelae from meningitis	QALY decrements	0.400	Morrow A 2007	Torrance G 1982[2]
Claes C 2009	Germany	All ages	Neurological sequelae	QALY decrements	0.10	Prosser LA 2004[2]	Prosser LA 2004[2]
Ta A 2024	Germany	All ages	Disability	Utility	0.680	Oostenbrink R 2002	Oostenbrink R 2002
Castiglia P 2017	Italy	0-18	Neurological sequelae meningitis	QALY decrements	0.400	Morrow A 2007	Torrance G 1982[2]
Ansaldi F 2020	Italy	All ages	Neurologic impairment	QALY decrements	0.40	Morrow A 2007	Torrance G 1982[2]
Diez-Domingo J 2011	Spain	All ages	Disability	Utility	0.53	Oosterbrink R 2000; Erickson LJ 2001	Oosterbrink R 2000; Erickson LJ 2001
Bos JM 2003	Netherlands	All ages	Mental retardation	Utility	0.75	Stouthard ME 1997	Stouthard ME 1997
Bos JM 2003	Netherlands	All ages	Spasticity	Utility	0.83	Stouthard ME 1997	Stouthard ME 1997
Bos JM 2003	Netherlands	All ages	Seizures	Utility	0.89	Stouthard ME 1997	Stouthard ME 1997
Hubben GA 2007	Netherlands	All ages	Mental retardation	Utility	0.75	Stouthard ME 1997	Stouthard ME 1997
Hubben GA 2007	Netherlands	All ages	Spasticity	Utility	0.83	Stouthard ME 1997	Stouthard ME 1997

Hubben GA 2007	Netherlands	All ages	Seizures	Utility	0.89	Stouthard ME 1997	Stouthard ME 1997
Rozenbaum MH 2010a	Netherlands	All ages	Disability (requiring intensive round-the-clock care)	Utility	0.47	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2010b	Netherlands	All ages	Disability (requiring intensive round-the-clock care)	Utility	0.47	Oostenbrink R 2002	Oostenbrink R 2002
Vermer P 2014	Netherlands	All ages	Mental retardation	Utility	0.620	Oostenbrink R 2002	Oostenbrink R 2002
Vermer P 2014	Netherlands	All ages	Spasticity	Utility	0.619	WHO 2004[2]	WHO 2004[2]
Vermer P 2014	Netherlands	All ages	Epilepsy	Utility	0.830	Oostenbrink R 2002	Oostenbrink R 2002
Blank PR 2012	Switzerland	All ages	Disability	Quality adjustment factor	0.6	Bovier PA 1999; Harris AHD 1994	Drummond MF 1986; Torrance G 1982[2]
Robberstad B 2011	Norway	All ages	Neurologic sequelae	QALY decrements	0.4	Morrow A 2007	Torrance G 1982[2]
By A 2012	Sweden	All ages	Neurologic sequelae from meningitis	QALY decrements	0.400	Morrow A 2007	Torrance G 1982[2]
By A 2012	Sweden	All ages	Neurologic sequelae from bacteremia	QALY decrements	0.400	Morrow A 2007	Torrance G 1982[2]
Talbird SE 2010	Canada, Germany, Mexico and Norway	All ages	Neurological sequelae	QALY decrements	0.400	Morrow A 2007	Torrance G 1982[2]
Knerer G 2012	Canada and UK	All ages	Neurological sequelae (meningitis)	QALY decrements	0.400	Morrow A 2007	Torrance G 1982[2]
Strutton DR 2012	Germany, Greece and Netherlands	All ages	Meningitis-caused neurological impairment	Utility	0.47	Oostenbrink R 2002	Oostenbrink R 2002
Strutton DR 2012	Germany, Greece and Netherlands	All ages	Meningitis-caused epilepsy	Utility	0.83	Oostenbrink R 2002	Oostenbrink R 2002
Pugh S 2020	Columbia, Finland and Netherlands	All ages	Neurologic impairment	QALY decrements	0.40	Morrow A 2007	Torrance G 1982[2]
Klok RM 2013	Denmark and Sweden	All ages	Meningitis-caused neurological impairment	Utility	0.47	Oostenbrink R 2002	Oostenbrink R 2002
Klok RM 2013	Denmark and Sweden	All ages	Meningitis-caused epilepsy	Utility	0.83	Oostenbrink R 2002	Oostenbrink R 2002
Rubin JL 2010a	US	All ages	Deafness	Utility	0.73	Erickson LJ 2001	Erickson LJ 2001
Rubin JL 2010b	US	All ages	Deafness	Utility	0.73	Erickson LJ 2001	Erickson LJ 2001
Stoecker C 2013	US	0-10	Deafness	Utility	0.73	Rubin JL 2010a	Erickson LJ 2001
McGarry LJ 2013	US	All ages	Deafness	Utility	0.73	Rubin JL 2010b	Erickson LJ 2001
Huang M 2023	US	All ages	Hearing loss	Utility	0.73	Rubin JL 2010a	Erickson LJ 2001
Prasad N 2023[1]	US	All ages	Deafness	QALY decrements	0.2137	Tang Z 2022	Oostenbrink R 2002; Koomen I 2003[3]; Carroll A 2009; Kulpeng W 2013
Rozenbaum MH 2024b	US	All ages	Deafness	Utility	0.730	Rubin LJ 2010; Erickson LJ 2001	Erickson LJ 2001

Rozenbaum MH 2024c	US	All ages	Deafness	Utility	0.730	Rubin LJ 2010; Erickson LJ 2001	Erickson LJ 2001
De Wals P 2009	Canada	All ages	Bilateral hearing loss (first year)	QALY decrements	0.460	Melegaro A 2004	Cheng AK 1999
De Wals P 2009	Canada	All ages	Bilateral hearing loss (subsequent years)	QALY decrements	0.200	Melegaro A 2004	Cheng AK 1999
De Wals P 2009	Canada	All ages	Other hearing loss (all subsequent years)	QALY decrements	0.100	Melegaro A 2004	Oostenbrink 2002
Chuck AW 2010	Canada	All ages	Hearing loss	QALY decrements	0.20	Morrow A 2007	Torrance G 1982[2]
Earnshaw SR 2012	Canada	All ages	Hearing loss	Utility	0.8	Morrow A 2007	Torrance G 1982[2]
Wilson M 2018	Canada	All ages	Hearing loss	QALY decrements	0.20	Morrow A 2007; Cheng AK 1999	Torrance G 1982[2]; Cheng AK 1999
Lytle D 2023	Canada	All ages	Deafness	Utility	0.730	Erickson LJ 2001	Erickson LJ 2001
Melegaro A 2004	UK	All ages	Bilateral hearing loss (first year)	QALY decrements	0.460	Cheng AK 1999	Cheng AK 1999
Melegaro A 2004	UK	All ages	Bilateral hearing loss (subsequent years)	QALY decrements	0.200	Cheng AK 1999	Cheng AK 1999
Melegaro A 2004	UK	All ages	Other hearing loss (all subsequent years)	QALY decrements	0.100	Oostenbrink R 2002	Oostenbrink R 2002
Van Hoek AJ 2012	UK	All ages	Deafness	Utility	0.81	Oostenbrink R 2002	Oostenbrink R 2002
Van Hoek AJ 2012	UK	All ages	Mild hearing loss	Utility	0.91	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2012	UK	>=2	Deafness	Utility	0.81	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2012	UK	>=2	Mild hearing loss	Utility	0.91	Oostenbrink R 2002	Oostenbrink R 2002
Delgleize E 2016	UK	All ages	Hearing loss from meningitis	QALY decrements	0.200	Morrow A 2007	Torrance G 1982[2]
Claes C 2009	Germany	All ages	Hearing loss first year	QALY decrements	0.46	Prosser LA 2004[2]	Prosser LA 2004[2]
Kuhlmann A 2017	Germany	All ages	Hearing loss	QALY decrements	0.0900	Melegaro A 2004	Oostenbrink R 2002
Ta A 2024	Germany	All ages	Disability	Utility	0.730	Erickson LJ 2001	Erickson LJ 2001
Castiglia P 2017	Italy	0-18	Hearing loss from meningitis	QALY decrements	0.200	Morrow A 2007	Torrance G 1982[2]
Ansaldi F 2020	Italy	All ages	Hearing loss	QALY decrements	0.20	Morrow A 2007	Torrance G 1982[2]
Diez-Domingo J 2011	Spain	All ages	Deafness	Utility	0.45	Oosterbrink R 2000; Erickson LJ 2001	Oosterbrink R 2000; Erickson LJ 2001
Beutels P 2011	Belgium	All ages	Bilateral hearing loss from meningitis (first year)	QALY decrements	0.460	Melegaro A 2004	Cheng AK 1999
Beutels P 2011	Belgium	All ages	Bilateral hearing loss from meningitis (every later)	QALY decrements	0.2	Melegaro A 2004	Cheng AK 1999
Bos JM 2003	Netherlands	All ages	Unilateral hearing loss	Utility	0.89	Stouthard ME 1997	Stouthard ME 1997
Bos JM 2003	Netherlands	All ages	Bilateral hearing loss	Utility	0.77	Stouthard ME 1997	Stouthard ME 1997
Hubben GA 2007	Netherlands	All ages	Unilateral hearing loss	Utility	0.89	Stouthard ME 1997	Stouthard ME 1997

Hubben GA 2007	Netherlands	All ages	Bilateral hearing loss	Utility	0.77	Stouthard ME 1997	Stouthard ME 1997
Rozenbaum MH 2010a	Netherlands	All ages	Bilateral hearing loss during the first year	Utility	0.55	Krabbe PF 2000	Krabbe PF 2000
Rozenbaum MH 2010a	Netherlands	All ages	Hearing loss after implanting a Cochlear hearing device	Utility	0.82	Krabbe PF 2000	Krabbe PF 2000
Rozenbaum MH 2010a	Netherlands	All ages	All other types of hearing loss	Utility	0.91	Oostenbrink R 2002	Oostenbrink R 2002
Rozenbaum MH 2010b	Netherlands	All ages	Bilateral hearing loss during the first year	Utility	0.55	Krabbe PF 2000	Krabbe PF 2000
Rozenbaum MH 2010b	Netherlands	All ages	Hearing loss after implanting a Cochlear hearing device	Utility	0.82	Krabbe PF 2000	Krabbe PF 2000
Rozenbaum MH 2010b	Netherlands	All ages	All other types of hearing loss	Utility	0.91	Oostenbrink R 2002	Oostenbrink R 2002
Vermer P 2014	Netherlands	All ages	Slight hearing problems	Utility	0.910	Oostenbrink R 2002	Oostenbrink R 2002
Vermer P 2014	Netherlands	All ages	Bilateral hearing problems (first year)	Utility	0.550	Krabbe PF 2000	Krabbe PF 2000
Vermer P 2014	Netherlands	All ages	Bilateral hearing problems (cochlear device)	Utility	0.820	Krabbe PF 2000	Krabbe PF 2000
Blank PR 2012	Switzerland	All ages	Hearing loss	Quality adjustment factor	0.8	Bovier PA 1999; Harris AHD 1994	Drummond MF 1986; Torrance G 1982[2]
Salo H 2005	Finland	0-5	Profoundly deaf (first year)	QALY decrements	0.216	Aromma A 2004[2]	Aromma A 2004[2]
Salo H 2005	Finland	0-5	Profoundly deaf (subsequent years)	QALY decrements	0.054	Aromma A 2004[2]	Aromma A 2004[2]
Salo H 2005	Finland	0-5	Needs hearing aid	QALY decrements	0.054	Aromma A 2004[2]	Aromma A 2004[2]
Salo H 2005	Finland	0-5	Moderate hearing loss	QALY decrements	0.054	Aromma A 2004[2]	Aromma A 2004[2]
Robberstad B 2011	Norway	All ages	Hearing loss from meningitis	QALY decrements	0.2	Morrow A 2007	Torrance G 1982[2]
By A 2012	Sweden	All ages	Hearing loss from meningitis	QALY decrements	0.200	Morrow A 2007	Torrance G 1982[2]
By A 2012	Sweden	All ages	Hearing loss from bacteremia	QALY decrements	0.200	Morrow A 2007	Torrance G 1982[2]
Talbird SE 2010	Canada, Germany, Mexico and Norway	All ages	Hearing loss	QALY decrements	0.200	Cheng AK 1999; Morrow A 2007	Cheng AK 1999
Knerer G 2012	Canada and UK	All ages	Hearing loss (meningitis)	QALY decrements	0.200	Morrow A 2007	Torrance G 1982[2]
Strutton DR 2012	Germany, Greece and Netherlands	All ages	Meningitis-caused hearing loss	Utility	0.81	Oostenbrink R 2002	Oostenbrink R 2002
Pugh S 2020	Columbia, Finland and Netherlands	All ages	Hearing loss	QALY decrements	0.20	Morrow A 2007; Cheng AK 1999	Torrance G 1982[2]; Cheng AK 1999

Klok RM 2013	Denmark and Sweden	All ages	Meningitis-caused hearing loss	Utility	0.81	Oostenbrink R 2002	Oostenbrink R 2002
PMS							
Poirier B 2009[4]	Canada	All ages	Survivor with sequelae of meningitis	QALY decrements	0.200	Melegaro 2004	Cheng AK 1999
Kuhlmann A 2017[5]	Germany	All ages	Multiple sequelae	QALY decrements	0.5300	Rozenbaum MH 2010a	Oostenbrink R 2002
Ess SM 2003	Switzerland	All ages	Sequelae from meningitis (mental retardation, cerebral palsy and deafness)	Quality adjustment factor	0.6	Bovier PA 1999; Harris AHD 1994	Drummond MF 1986; Torrance G 1982[2]
Others							
Diez-Domingo J 2011	Spain	All ages	Blindness	Utility	0.40	Oosterbrink R 2000; Erickson LJ 2001	Oosterbrink R 2000; Erickson LJ 2001

Abbreviations: PMS=Post-meningitis sequelae; CUA=Cost-utility analysis; US=United States; QALY=Quality-adjusted life year; UK=United Kingdom; GP=General practitioner; WHO=World Health. Organization.

Notes:

1. Prasad N (2023) used the inverse variance weighted average of QALY estimates from the meta-analysis conducted by Tang Z et al. (2022) as the base-case input.
2. The health utility inputs were not identified in the source studies. Nor did the source studies estimated the utility values for the relevant conditions.
3. Koomen I (2003) did not estimate the utility for hearing loss, instead it provided the utility estimate for all school-aged meningitis survivors.
4. The input value was estimated based on disutility for bilateral hearing loss after meningitis (subsequent years).
5. The input value was estimated based on utility for neurological sequelae.

References

1. Beutels P, Blommaert A, Hanquet G, Bilcke J, Thiry N, Sabbe M, et al. Cost-effectiveness of 10- and 13-valent pneumococcal conjugate vaccines in childhood. KCE reports 155C.2011.
2. Bos JM, Rümke H, Welte R, Postma MJ. Epidemiologic impact and cost-effectiveness of universal infant vaccination with a 7-valent conjugated pneumococcal vaccine in the Netherlands. Clin Ther. 2003 Oct;25(10):2614-30.
3. Hubben GA, Bos JM, Glynn DM, van der Ende A, van Alphen L, Postma MJ. Enhanced decision support for policy makers using a web interface to health-economic models--illustrated with a cost-effectiveness analysis of nation-wide infant vaccination with the 7-valent pneumococcal conjugate vaccine in the Netherlands. Vaccine. 2007 May 4;25(18):3669-78.
4. Kuhlmann A, von der Schulenburg JG. Modeling the cost-effectiveness of infant vaccination with pneumococcal conjugate vaccines in Germany. Eur J Health Econ. 2017 Apr;18(3):273-92.
5. Ray GT, Whitney CG, Fireman BH, Ciuryla V, Black SB. Cost-effectiveness of pneumococcal conjugate vaccine: evidence from the first 5 years of use in the United States incorporating herd effects. Pediatr Infect Dis J. 2006 Jun;25(6):494-501.
6. Rozenbaum MH, Chilson E, Farkouh R, Huang L, Cane A, Arguedas A, et al. Cost-Effectiveness of 20-Valent Pneumococcal Conjugate Vaccine Among US Children with Underlying Medical Conditions. Infect Dis Ther. 2024 Apr;13(4):745-60.
7. Lytle D, Grajales Beltrán AG, Perdrizet J, Ait Yahia N, Cane A, Yarnoff B, et al. Cost-effectiveness analysis of PCV20 to prevent pneumococcal disease in the Canadian pediatric population. Hum Vaccin Immunother. 2023 Aug;19(2):2257426.
8. Tang Z, Matanock A, Jeon S, Leidner AJ. A review of health-related quality of life associated with pneumococcal disease: pooled estimates by age and type of disease. J Public Health (Oxf). 2022 Jun 27;44(2):e234-e40.
9. Bennett JE, Sumner W, 2nd, Downs SM, Jaffe DM. Parents' utilities for outcomes of occult bacteremia. Arch Pediatr Adolesc Med. 2000 Jan;154(1):43-8.
10. Prosser LA, Ray GT, O'Brien M, Kleinman K, Santoli J, Lieu TA. Preferences and willingness to pay for health states prevented by pneumococcal conjugate vaccine. Pediatrics. 2004 Feb;113(2):283-90.
11. Prasad N, Stoecker C, Xing W, Cho BH, Leidner AJ, Kobayashi M. Public health impact and cost-effectiveness of 15-valent pneumococcal conjugate vaccine use among the pediatric population of the United States. Vaccine. 2023 May 2;41(18):2914-21.
12. Wilson M, Lucas A, Mendes D, Vyse A, Mikudina B, Czudek C, et al. Estimating the Cost-Effectiveness of Switching to Higher-Valency Pediatric Pneumococcal Conjugate Vaccines in the United Kingdom. Vaccines (Basel). 2023 Jun 28;11(7).
13. By A, Sobocki P, Forsgren A, Silfverdal SA. Comparing health outcomes and costs of general vaccination with pneumococcal conjugate vaccines in Sweden: a Markov model. Clin Ther. 2012 Jan;34(1):177-89.
14. Castiglia P, Pradelli L, Castagna S, Freguglia V, Palù G, Esposito S. Overall effectiveness of pneumococcal conjugate vaccines: An economic analysis of PHiD-CV and PCV-13 in the immunization of infants in Italy. Hum Vaccin Immunother. 2017 Oct 3;13(10):2307-15.
15. Delgleize E, Leeuwenkamp O, Theodorou E, Van de Velde N. Cost-effectiveness analysis of routine pneumococcal vaccination in the UK: a comparison of the PHiD-CV vaccine and the PCV-13 vaccine using a Markov model. BMJ Open. 2016 Nov 30;6(11):e010776.
16. Knerer G, Ismaila A, Pearce D. Health and economic impact of PHiD-CV in Canada and the UK: a Markov modelling exercise. J Med Econ. 2012;15(1):61-76.
17. Robberstad B, Frostad CR, Akselsen PE, Kværner KJ, Berstad AK. Economic evaluation of second generation pneumococcal conjugate vaccines in Norway. Vaccine. 2011 Nov 3;29(47):8564-74.
18. Talbird SE, Taylor TN, Knoll S, Frostad CR, García Martí S. Outcomes and costs associated with PHiD-CV, a new protein D conjugate pneumococcal vaccine, in four countries. Vaccine. 2010 Nov 19;28 Suppl 6:G23-9.

19. van Hoek AJ, Choi YH, Trotter C, Miller E, Jit M. The cost-effectiveness of a 13-valent pneumococcal conjugate vaccination for infants in England. Vaccine. 2012 Nov 26;30(50):7205-13.
20. Blank PR, Szucs TD. Cost-effectiveness of 13-valent pneumococcal conjugate vaccine in Switzerland. Vaccine. 2012 Jun 13;30(28):4267-75.
21. Salo H, Sintonen H, Nuorti JP, Linna M, Nohynek H, Verho J, et al. Economic evaluation of pneumococcal conjugate vaccination in Finland. Scand J Infect Dis. 2005;37(11-12):821-32.
22. Vold Pepper P, Owens DK. Cost-effectiveness of the pneumococcal vaccine in the United States Navy and Marine Corps. Clin Infect Dis. 2000 Jan;30(1):157-64.
23. O'Brien MA, Prosser LA, Paradise JL, Ray GT, Kulldorff M, Kurs-Lasky M, et al. New vaccines against otitis media: projected benefits and cost-effectiveness. Pediatrics. 2009 Jun;123(6):1452-63.
24. Claes C, Reinert RR, von der Schulenburg JM. Cost effectiveness analysis of heptavalent pneumococcal conjugate vaccine in Germany considering herd immunity effects. Eur J Health Econ. 2009 Feb;10(1):25-38.
25. Oh PI, Maerov P, Pritchard D, Knowles SR, Einarson TR, Shear NH. A cost-utility analysis of second-line antibiotics in the treatment of acute otitis media in children. Clin Ther. 1996 Jan-Feb;18(1):160-82.
26. Oostenbrink R, HA AM, Essink-Bot ML. The EQ-5D and the Health Utilities Index for permanent sequelae after meningitis: a head-to-head comparison. J Clin Epidemiol. 2002 Aug;55(8):791-9.
27. Morrow A, De Wals P, Petit G, Guay M, Erickson LJ. The burden of pneumococcal disease in the Canadian population before routine use of the seven-valent pneumococcal conjugate vaccine. Can J Infect Dis Med Microbiol. 2007 Mar;18(2):121-7.
28. Torrance GW. Preferences for health states: a review of measurement methods. Mead Johnson Symp Perinat Dev Med. 1982(20):37-45.
29. Erickson LJ, De Wals P, McMahon J, Heim S. Complications of meningococcal disease in college students. Clin Infect Dis. 2001 Sep 1;33(5):737-9.
30. Cheng AK, Niparko JK. Cost-utility of the cochlear implant in adults: a meta-analysis. Arch Otolaryngol Head Neck Surg. 1999 Nov;125(11):1214-8.