

Appendix A

Strength of scientific research by levels of evidence

Grade of recommendation	Evidence level	General study type	Study design
A	I	Experimental	Randomized controlled trial
			Systematic review of randomized controlled trial, with or without meta-analysis
B	II	Quasi-experimental	Systematic review of randomized controlled trial and/or quasi-experimental studies (e.g., cohort studies), with or without meta-analysis
			Systematic review of randomized controlled trial, quasi-experimental studies, and/or non-experimental studies (e.g., case-control studies), with or without meta-analysis
	III	Non-experimental	Qualitative study Case control studies Case series
C	IV	Expert/consensus opinion based on scientific evidence	Clinical practice guidelines
			Consensus panels
D	V	Experiential and non-research evidence	Literature review
			Quality improvement, program, or financial evaluation
			Case reports Expert opinion

Appendix B

Quality of life measures for children and families

Author(s)	Measure	Generic, hearing loss- specific, or family- related	Age range (years)	Self- report	Parent report	Number of items	Domains
Varni et al. (1999)	Pediatric Quality of Life Inventory (PedsQL)	Generic	2-18		X	42	Physical functioning, emotional functioning, social functioning, school functioning, multidimensional fatigue scale
			5-18	X	X	42	
Ravens-Sieberger & Bullinger (2000)	KINDL ^R (Kiddy-KINDL)	Generic	4-7	X	X	12 (child), 46 (parent)	Physical well-being, emotional well-being, self-esteem, family, friends, school
	KINDL ^R (Kid-KINDL)	Generic	8-11	X	X	24	
	KINDL ^R (Kiddo-KINDL)	Generic	12-16	X	X	24	
Riley et al. (2004); Starfield et al. (1993)	Child Health and Illness Profile (CHIP)	Generic	6-18	X	X	45	Satisfaction, comfort, risks, resilience, achievement

Archbold et al. (2008)	Children with cochlear implants: Parental perspectives	Hearing loss-specific	1-12		X	74	Communication, general functioning, self-reliance, well-being, social relations, education, effects of implantation, supporting the child, process of implantation
Hoffman et al. (2019)	Quality of life – Cochlear implant (QOL-CI)	Hearing loss-specific	6-12	x	x	33	Noisy environments, academic functioning, child acceptance, oral communication, social functioning, fatigue, emotional functioning, device management
Patrick et al. (2011)	Youth Quality of Life Instrument for Youth who are Deaf or Hard of Hearing (YQoL-DHH)	Hearing loss-specific	5-10		X		Self-acceptance/advocacy, perceived stigma, participation
			11-18	X		32	
Umansky et al. (2011)	Hearing Environments and Reflection on Quality of Life (HEAR-QL-26)	Hearing loss-specific	7-12	X		28	Environments, activities, feelings
Umansky et al. (2011)	Hearing Environments and Reflection on Quality of Life (HEAR-QL-28)	Hearing loss-specific	13-18	X		28	Hearing situations, social interactions, school difficulties, feelings
Abidin, 1995	Parenting Stress Index-Short Form (PSI)	Family-related	0-18		X	36	Parental distress, parent-child dysfunctional interaction, difficult child

Desjardin, 2003	Scale of Parent Involvement and Self-Efficacy (SPISE) for Young Children with Hearing	Family-related	0-18	X	10	Self-efficacy
					11	Parental involvement
Dunst et al., 1984	Support System Questionnaire	Family-related	0-18	X	9	Formal support
					14	Informal support
Friedrich et al., 1983	Questionnaire on Resources and Stress – Short Form (QRS-SF)	Family-related	0-18	X	52	Parent and family problems, pessimism, child characteristics, physical incapacitation
Guimond et al., 2008	Early intervention parental self-efficacy scale	Family-related	0-18	X	16	Self-efficacy
Meadow-Orlans, 1990	Impact of Childhood HL on the Family	Family-related	0-18	X	8	Family stress subscale
Moeller, 2000	Family Participation Rating Scale	Family-related	0-18	X	1	Family involvement (e.g., familial adjustment, session participation, effectiveness of communication with the child advocacy efforts)
Quittner et al., 1990; Quittner et al., 1991	Family Stress Scale (FSS)	Family-related	0-18	X	14	General family stressors (e.g., finances, discipline) and hearing-specific stressors (e.g., communication, managing technology)

Weisbol, 1973	Parental Acceptance Questionnaire	Family- related	30	Parental acceptance
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Appendix C

Speech recognition measures for children

Author(s)	Measure	Age range (years)	Language level	Discrimination	Word stimuli (quiet)	Sentence stimuli (quiet)	Sentence stimuli (noise)
Uhler et al. (2017)	VRISD	.5-1.0	Receptive: single words, short phrases	X			
Moog & Geers (1990)	Early Speech Perception – Low verbal (ESP-LV)	2-3	Receptive: Follows brief instructions; Expressive: 2-3 word phrases		X		
Moog & Geers (1990)	Early Speech Perception – Standard (ESP-S)	3-4	Receptive: Follows brief instructions; Expressive: 3 word sentences		X		
Jerger & Jerger (1984)	Pediatric Speech Intelligibility (PSI)	2-4	Receptive: Follows brief instructions; Expressive: 2-33 word sentences		X	X	X
Kirk et al. (1995)	Multisyllabic Lexical Neighborhood Test (MLNT)	3-5	Receptive: Follows simple instructions; Expressive: 3-5 word sentences		X		

Kirk et al. (1995)	Lexical Neighborhood Test (LNT)	>4	Receptive: Follows simple instructions; Expressive: 3-5 word sentences	X	
Peterson & Lehiste (1962)	Consonant-Nucleus- Consonant test (CNC)	>4	Receptive: Follows simple instructions; Expressive: 3-5 word sentences	X	
Bench et al. (1979); Etymotic Research (2005)	Bamford-Kowal- Bench sentences in quiet (BKB) and in noise (BKB-SIN)	>5	Receptive: Follows 3-part commands; Expressive: Mostly correct grammar	X	X
Spahr et al. (2014)	Pediatric AzBio	>5	Receptive: Follows 3-part commands; Expressive: Mostly correct grammar	X	X

Note. Rows shaded in grey indicate closed-set speech recognition measures.

Appendix D

Functional listening measures for children

Author(s)	Measure	Age range (years)	Suprasegmental characteristics (e.g., rhythm, stress, syllables)	Speech identification	Consonants and vowels (e.g., place, voicing)	Listening environments (e.g., quiet, noise, distance)
Ling (1976, 1989)	Ling 6 sounds	(all)			X	
Meinzen-Derr et al. (2007)	Auditory Skills Checklist (ASC)	(all)		X	X	
Wilkes & Children (2001)	Cottage Acquisition Scales for Listening, Language, and Speech (CASLLS)	0-9	X	X		
Zimmerman-Phillips et al. (2000)	Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS)	0-3	X			
Ching & Hill (2007)	Parents' Evaluation of Aural/Oral Performance of Children (PEACH)	0-5		X		X
Stredler-Brown & Johnson (2001, 2003)	Functional Auditory Performance Indicators (FAPI)		X			

Kuehn-Inacker et al. (2003)	LittleEARS	0-2 (post- implant)	X	X	
Robbins et al.	Meaningful Auditory Integration Scale (MAIS)	>2	X	X	
Moog & Geers (1990)	Early Speech Perception Test (ESP)	>3	X	X	
Ertmer (2003)	Contrasts for Auditory and Speech Training	>3	X	X	X
Moog et al. (1995)	Speech Perception Instructional Curriculum and Evaluation (SPICE)	>3	X	X	
Walker (2009)	Auditory Learning Guide	(all)			X
Ertmer (2015)	Open and Closed Set Test	0-2 (post- implant)			X
Sindrey (2014)	Compass Test of Auditory Discrimination	≥ 5			X

Johnson & Van Almen (1997)	Functional Listening Evaluation (FL)	≥ 5
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x

Appendix E

Vaccinations associated with pediatric cochlear implantation

Chronologic age	PCV 13	Hib	PPSV23
1 month	X		
2 months	X	X	
4 months	X	X	
6 months	X	X	
12-15 months	X	X	
>15 months (if received PCV7 series)	X		
≥ 2 years			X

Note. PCV 13 = pneumococcal conjugate vaccine 13 valent; PCV 7 = pneumococcal conjugate vaccine 7 valent; Hib = Haemophilus influenza type b; PPSV23 = pneumococcal polysaccharide vaccine

Typically, a physician will discuss the required vaccinations with the families of pediatric cochlear implant candidates. (For more information about recommended vaccinations from the Centers for Disease Control, please go to <https://www.cdc.gov/vaccines/vpd/mening/public/dis-cochlear-faq-gen.html>).

Children should receive pneumococcal conjugate vaccine 13 valent (PCV 13) on the recommended schedule appropriate for their age (i.e., 1 month, 2 months, 4 months, 12-15 months). Older children who received the pneumococcal conjugate vaccine 7 valent (PCV 7) as part of their

childhood vaccine series should get one dose of PCV 13 prior to implantation. Children younger than 5 years of age should receive the Haemophilus influenza type b (Hib) on the recommended schedule for their age (i.e., 2 months, 4 months, 6 months, 12-15 months). Finally, all children 2 years of age and older should receive the pneumococcal polysaccharide vaccine (PPSV23) prior to implantation. Typically, a physician will discuss the required vaccinations with the families of pediatric cochlear implant candidates. (

Appendix F

Standardized speech and language measures for children

Author(s)	Measure	Age range (years;months)	Articulation	Lexical/semantic (e.g., Vocabulary)	Syntax	Phonology and morphology	Pragmatics
Fudala & Stegall (2017)	Arizona Articulation and Phonology Scale-4	1;5-18	X				
Goldman & Fristoe (2015)	Goldman-Fristoe Test of Articulation-3	2;0-21;0	X				
Fenson et al. (2007)	MacArthur-Bates Communicative Developmental Inventory; Words and Gestures (MBCDI: WG)	0;8-1;6		X			
Fenson et al. (2007)	MacArthur-Bates Communicative Developmental Inventory (Words and Sentences (MBCDI: WS)	1;4-2;6		X			
Brown et al. (2020)	Receptive- Expressive Emergent Language Test, Fourth Edition (REEL-4)	Birth-3;0		X			

Zimmerman et al. (2011)	Preschool Language Scale-5 (PLS-5)	Birth-7;11	X	X	X	X
Reynell & Gruber (1990)	Reynell Developmental Language Scales (RDLs)	2;0-7;0		X		
Williams (2018)	Expressive Vocabulary Test-4 (EVT-4)	2;6-adult		X		
Dunn & Dunn (2007)	Peabody Picture Vocabulary Test-4 (PPVT-4)	2;6-adult		X		
Brownell (2010)	Receptive One- word Picture Vocabulary Test (ROWPVT)	2;11-11;11		X		
Brownell (2010)	Expressive One- word Picture Vocabulary Test (EOWPVT)	2;0-11;11		X		
Carrow- Wollfolk (2011)	Oral and Written Language Scales- II (OWLS-II)	3;0-21;11		X	X	X
Carrow- Wollfolk (2011)	Comprehensive Assessment of Spoken Language- 2 (CASL-2)	3;0-21;0		X	X	X

Wiig et al. (2013)	Clinical Evaluation of Language Fundamentals-5 (CELF-5)	5;0-21;11	X	X	X	X
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