Chapter 1

Introduction To Paediatric Audiology

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'Children are the world's most valuable resource and its best hope for the future. Ensuring their ability to hear and communicate effectively is paramount, for it is through their ears that they will discover the wonders of language, music, and the world around them.'

~Helen Keller

Paediatric audiology

The concept of paediatric audiology began shortly after the development of the discipline of audiology during and following World War II (Tharpe and Seewald 2016). During the twentieth century educators and healthcare professionals across the United States found themselves compelled to participate in the identification, assessment and care of very young children with hearing loss (HL) out of sheer necessity. However, only in the 1950s was paediatric audiology recognised, when Sir Alexander and Lady Irene Ewing introduced some of the fundamental concepts now associated with paediatric audiology: the benefits of early identification and intervention including assistive hearing technology, the importance of caregiver involvement and training at home for the development of speech and language, and the effective approaches for accurate assessment of young children with HL. The profession has developed tremendously since then, with advances in technology for both the assessment and management of HL. However, the goals remain the same: to support children and their families to reach their full potential.

The scope of practice for hearing healthcare professionals (HHPs) includes the prevention of HL, identification and/or screening, assessment and diagnosis of HL and the management thereof through counselling and advocacy (Department of Health 2012). When working with the paediatric population, these aspects need to be individualised for each child based on his or her developmental and/or chronological age (American Academy of Audiology [AAA] 2020). It is thus the responsibility of the HHP to determine the appropriate test procedures to use for each child, after which a diagnosis of and appropriate recommendations for (re) habilitation should be made. The intervention options may be provided primarily by an HHP or in conjunction with an interdisciplinary team of clinicians. Intervention should aim to reduce the impact of the HL and can include non-implantable amplification or implantable amplification devices, communication and language intervention, educational accommodations and support services, auditory training, family-centred intervention and environmental modifications to optimise listening and learning outcomes.

It is also important to note that the journey of (re)habilitation for children is longitudinal, as children are continuously growing and developing. Hearing status and communication needs should thus be re-evaluated every three to six months, depending on the aetiology of the HL. The intervention/management should be adapted accordingly. Furthermore, technology advances rapidly, with new and improved device features being launched on the market regularly. It is thus of utmost importance for HHPs to keep abreast of the latest developments in order to provide the best possible (re)habilitation options.

Hearing loss in the paediatric population

Globally, over 430 million people require rehabilitation to address their disabling HL, of which 34 million are children (World Health Organization, 2021). Hearing loss in children may occur at any stage of development, from the prenatal period through adolescence, and may be associated with syndromic or non-syndromic aetiologies. HL aetiology may be congenital, have a delayed onset or be acquired during one's lifetime.

Hearing loss is considered congenital if identified shortly after birth. Known causes include congenital cytomegalovirus infection, structural abnormalities of the temporal bones, or genetic factors; however, approximately 50% of cases have no clearly identifiable aetiology (Lieu et al. 2020). A delayed onset HL is identified after the neonatal period but is still attributed to any aetiology that was present during birth (Lieu et al. 2020). Acquired HL is attributed to the effects of trauma, infection or ototoxic medications that occur during

childhood. It should also be noted that HL may occur in isolation or be accompanied with other challenges such as vision, cognitive and physical impairments.

The nature of HL, whether permanent or temporary, is usually (though not always) contingent upon its aetiology. If conductive, it is usually temporary in nature and is often associated with conditions such as otitis media (OM) or impacted earwax and is typically addressed through medical interventions. Recurrent conductive hearing loss (CHL) may also mask an underlying sensorineural (SN) component, making it a mixed hearing loss (MHL). It is thus important for clinicians to conduct a full test battery to determine the type of HL and its possible associated aetiology, and to conduct regular follow-up evaluations to ensure that any SN component is not missed. A permanent HL can encompass CHL, MHL and SNHL, and may also include Auditory Neuropathy Spectrum Disorder (ANSD). A breakdown anywhere along the auditory pathway can disrupt the effective use of auditory information. When auditory input cannot be processed effectively, the consequences can be profound if left unaddressed. HL, whether permanent or temporary, and regardless of its nature, requires supportive interventions. Chapter 2 offers an in-depth examination of the prevalence and characteristics of HL within paediatric populations, with Chapter 3 focusing on the auditory anatomy and physiology in particular relation to paediatric HL.

The consequences of untreated hearing loss in the paediatric population are pervasive and multifaceted, affecting the quality and quantity of accessible spoken language, which in turn has downstream effects on speech development, literacy, psychosocial development, mental health, educational attainment and vocational opportunities (Convery et al. 2013). This is particularly relevant given that approximately 90% of deaf and hard-of-hearing children are born to hearing parents and are primarily exposed to spoken language in the home environment (Mitchell and Karchmer 2004). In addition, the effects of paediatric HL extend to the family of the child, often creating a change in dynamics that can subsequently generate tension and additional challenges within the family (Northern and Downs 2014). One of the most effective strategies for minimising or preventing such negative repercussions is the implementation of appropriate and timely intervention (Brodie, Smith and Ray 2018; Paul and Whitelaw 2011; Wang et al. 2019).

Extensive research spanning several decades has described positive outcomes for children whose HL is identified early and who undergo intervention promptly, compared to those with delayed detection and treatment (Antia et al. 2009; Haukedal et al. 2019; Tomblin et al. 2015; Walker et al. 2015; Yoshinaga-Itano et al. 2010). Studies indicate that children who are born

deaf or experience early-onset HL and are identified and receive appropriate interventions within six months of birth demonstrate language development comparable to their hearing peers by age five (Niparko et al. 2010; Yoshinaga-Itano et al. 2010).

There are two main approaches available in supporting the language acquisition of children with HL, which include 1) auditory-verbal (via assistive hearing technology and aural (re)habilitation) and 2) visual-manual (cued speech, signing etc.). A third approach, Total Communication, utilises aspects from both main approaches to facilitate optimal communication on an individual level. Regardless of the approach used, the key outcome for successful development and communication is to give the child and its family the necessary tools and support. The benefit of early intervention will extend to improved social and educational outcomes for this vulnerable population.

Resource constraints

Access to sustainable hearing healthcare resources is a prerequisite for the efficient delivery of hearing healthcare services to address the burden of HL, and improve the quality of life of paediatric patients and their families (Bhamjee et al. 2022; Chadha, Kamenov and Cieza 2021). These resources encompass human resources, equipment, infrastructure and financial assets. In addition, the maintenance and upkeep of these resources are important, for example, the annual calibration of all audiological equipment.

Unfortunately, the vast majority of children with HL live in low- and middle-income countries (LMICs). In these settings, access to services is often limited by barriers such as shortages of HHPs, the high cost of audiological test equipment, limited facilities and restricted access to hearing amplification technologies (Mulwafu et al. 2017; Swanepoel and Clark 2018; Wagner and Fagan, 2013; Waterworth et al. 2022). In South Africa, healthcare is divided between private and public systems, with the majority of the population (approximately 85%) relying on the public sector, where, particularly in low-resourced contexts, hearing healthcare is often not prioritised (Kerr, Tuomi and Müller. 2012; Mayosi and Benatar 2014; Pillay et al. 2020). A study conducted in South Africa focusing on newborn hearing screening (NHS) services within the public healthcare sector revealed that the shortage of HHPs who can conduct hearing screenings, along with limitations in screening equipment, poses significant obstacles to the successful implementation of NHS (Bezuidenhout et al. 2018). As a result, there is limited or delayed early identification of HL in South Africa.

Early identification and intervention are crucial in maximising the language and communication competence, psychosocial well-being and literacy development of children with HL (Joint Committee on Infant Hearing 2019). A large number of infants with HL will thus go undiagnosed and may only be identified later due to parental concerns or only once they enter the school system. Chapter 4 of this book focuses on how hearing screening helps HHPs to identify HL early for optimal developmental outcomes.

Population needs

Besides the lack of resources available, HHP may also face additional barriers such as not being able to communicate effectively with the child and their family due to cultural and linguistic differences. Provision of culturally competent services necessitates understanding the unique and complex set of cultural and linguistic variables that each client brings to the interaction and responding with sensitivity and adaptability to these variables (Lowell et al. 2018). In clinical settings, being responsive to others' needs, having flexible conceptual thinking and adapting traditional approaches are key factors for improving the quality and effectiveness of care across the diverse cultures, languages and ethnicities of our clients. In some settings, telehealth services may be beneficial in providing personalised care and decentralising hearing healthcare services (Chapter 16).

In addition to language barriers, the paediatric population is challenging to evaluate due to their inability to communicate directly with the clinician or their reduced attention span which can make it difficult to obtain reliable behavioural responses. In paediatric audiology, behavioural and physiologic testing methods are used to assess a child's hearing abilities. Behavioural testing relies on measuring the behavioural responses of the child to auditory stimuli. The results depend on the child's co-operation, attention and ability to understand the test instructions. Examples of behavioural testing include Behavioural Observation Audiometry (BOA), Visual Reinforcement Audiometry (VRA) and Play Audiometry. Physiologic testing methods do not rely on the child's behavioural responses. These tests measure physiological responses to auditory stimuli, providing additional valuable auditory information, especially in cases where the child cannot or will not co-operate with behavioural testing. Examples of physiologic testing include Otoacoustic Emissions (OAEs), Auditory Brainstem Response (ABR), Tympanometry and Acoustic Reflexes. There are several behavioural (Chapter 5) and physiologic (Chapter 6) test procedures that can be used as part of a protocol to assess and diagnose the degree and extent of the HL. The contents of this book will support HHPs in selecting assessments and management approaches that align with the child's language, cognitive and emotional development by providing practical recommendations.

Perspectives of this book

This book aims to serve as a comprehensive resource for both aspiring HHPs and practising clinicians. The book focuses on identification, assessment (Chapters 4-8) and (re)habilitation options (Chapters 9-13) for the paediatric population. Information on providing family-centred and interdisciplinary care is also discussed (Chapters 14-17). The figure below depicts the outline of the chapters in this book.

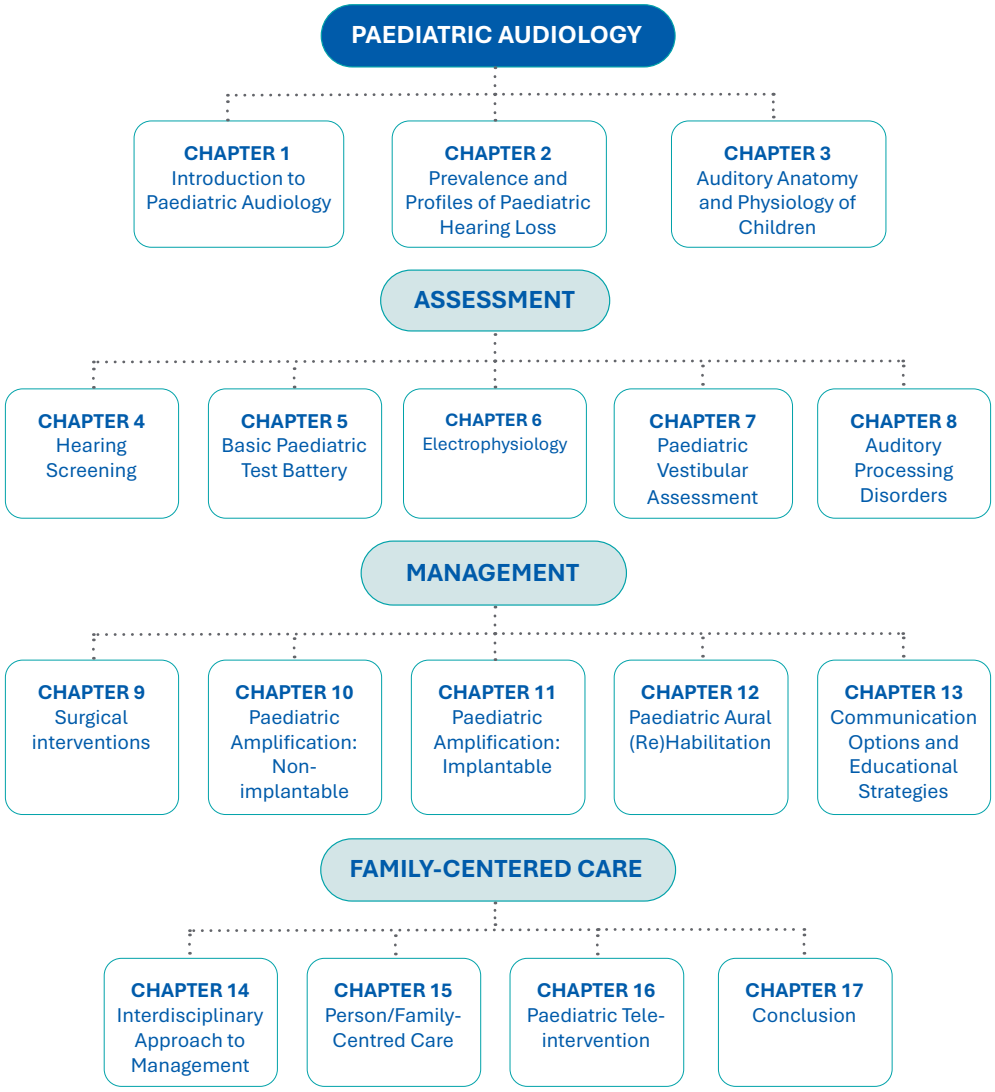


Figure 1.1. Outline of chapters to be included

Written and edited by experienced clinicians, this book aims to offer a unique blend of theoretical foundations and practical insights tailored to the complexities of paediatric audiology. With a focus on real-world strategies, this book strives to enhance clinical decision-making skills and optimise outcomes for young patients and their families.

Conclusion

Hearing care plays a crucial role in the pursuit of universal health coverage, aligning with Goal 3 of the Sustainable Development Goals for 2030 (UN Department of Economic and Social Affairs 2015). This objective aims to provide all individuals, including those with HL, access to services. The realisation of this goal necessitates the adoption of the recommendations of the World Health Organisation (2021), which includes following an integrated, person-centred approach to ear and hearing care (IPC-EHC). Through this book, the reader will obtain theoretical knowledge founded on evidence-based practices and real-world strategies to identify, assess and support children with HL, ensuring accessible and quality care.

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