# Toward Standardization of Pediatric Audiology Outcome Measures in Malaysia: A Conceptual Review of Current Practices, Challenges, and Recommendations

**Sarah Rahmat, Ph.D.,[1,2,3] Nor Haniza Abdul Wahat, Ph.D.,[3,4] Nur Azyani Amri, Ph.D.,[3,5] Siobhan Brennan, Ph.D.,[6] Darleena Abdul Aziz, B.Aud.,[3,7] Afzarini Hasnita Ismail, Ph.D.,[1,2,3] Nurul Syarida Mohd Sakeri, Ph.D.,[1,2,3] and Wan Najibah Wan Mohamad, Ph.D.[3,8]**

## ABSTRACT

Standardized outcome measures are essential for evidence-based pediatric audiology practice, yet Malaysia lacks unified national guidelines, risking inconsistent care quality and inequitable service delivery for children with hearing loss. This conceptual review presents a national perspective on pediatric audiology outcome measures, synthesizing findings from expert panel discussions, literature integration, and practice assessment through triangulation. Key insights were gathered through the Seventh Malaysian Audiology Scientific Conference forum, involving structured panels with government, private sector, and international representatives, plus insights from 180 forum participants. Current landscape analysis reveals public sector services follow established protocols with government investment in equipment upgrades, while private sector practices demonstrate significant variability. Critical gaps include sector variability, absence of unified standards, inadequate inter-facility comparison capabilities, and the need for tiered implementation approaches. Implementation challenges include fragmented service delivery, limited access to advanced tools

[1]Department of Audiology and Speech-Language Pathology, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia; [2]Children Health and Well-being Research Group, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia; [3]Malaysian National Society of Audiologists; [4]Center for Rehabilitation and Special Needs Studies, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Malaysia; [5]Audiology Unit, Department of Otorhinolaryngology, Hospital Raja Permaisuri Bainun, Ministry of Health, Malaysia; [6]Manchester Centre for Audiology and Deafness, University of Manchester, Manchester, United Kingdom; [7]Audiology and Vestibular Services, Prince Court Medical Centre, Kuala Lumpur, Malaysia; [8]Audiology Program, School of Health Sciences, Universiti Sains Malaysia.

Address for correspondence: Sarah Rahmat, Ph.D., Department of Audiology and Speech-Language Pathology, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, 25200 Kuantan, Pahang, Malaysia (e-mail: sarahrahmat@iium.edu.my).

Malaysian Audiology Scientific Conference (MASCO) 2025—Building Strong Foundations: The Evolution of Evidence-Based Practice in Audiology; Guest Editors, Onn Wah Lee, Ph.D., Afzarini Hasnita Ismail, Ph.D., Mohd Fadzil Nor Rashid, Ph.D.

Semin Hear 2025;46:1–13.  Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA
DOI: https://doi.org/10.1055/s-0045-1812880.
ISSN 0734-0451.

outside specialized centers, workforce and infrastructure gaps, and private sector constraints. International examples, particularly the Welsh Primary Care Audiology Pathway, demonstrate successful integration models enhancing service consistency and equity. Strategic recommendations propose a three-phase framework: foundation (stakeholder coordination), development (culturally-adapted standards), and sustainability (monitoring and evaluation). A national task force comprising key stakeholders is recommended to lead standardization efforts, ensuring consistent, evidence-based care for children with hearing loss across Malaysia's diverse healthcare settings.

**KEYWORDS:** outcome measures, pediatric audiology, standard, Malaysia

In pediatric audiology, the assessment of intervention effectiveness is essential to ensure clinical services produce meaningful and measurable benefits for children with hearing loss. This requires the systematic use of outcome measures, which are defined as tools or procedures used to evaluate the results of clinical interventions in terms of functional improvement, developmental progress, or quality of life (Bagatto et al., 2011). For clarity, it is important to distinguish between diagnostic tools and outcome measures: diagnostic tools (such as auditory brainstem response [ABR] for threshold estimation) are used for initial assessment and identification of hearing loss, while outcome measures (such as aided ABR, functional questionnaires, and speech perception assessments) are specifically employed to evaluate the effectiveness of interventions and to monitor progress over time. Certain procedures, such as pure tone audiometry (PTA) or ABR, can function both as diagnostic tools and outcome measures depending on context. In this paper, they are referred to as diagnostic tools when used for the initial identification and diagnosis of hearing loss, and as outcome measures when applied in a pre–post intervention framework to demonstrate change or benefit resulting from intervention. These outcome measures may be objective, such as electrophysiological (e.g., aided ABR) or behavioral test results (e.g., visual reinforcement audiometry [VRA]), or subjective, such as caregiver-completed questionnaires evaluating auditory behavior or speech perception in everyday environments.

The use of standardized outcome measures provides a foundation for evidence-based practice, enabling clinicians to monitor progress, identify the need for intervention adjustments, and ensure alignment with developmental goals (Bagatto et al., 2011). Without such standardization, clinical outcomes are at risk of being inconsistent, leading to disparities in care, inefficiencies, and increased risk of over- or under-treatment. Furthermore, even when clinicians use similar tools, variations in assessment protocols can result in inequitable quality of service, diagnostic errors, delays in intervention, and miscommunication between clinicians and families (Moeller et al., 2013).

Standardized measures also serve to guide early and accurate diagnosis, a critical factor in mitigating the adverse effects of hearing loss on speech, language, and cognitive development. Repeated use of validated tools allows for longitudinal tracking of a child's auditory and communicative progress, enabling clinicians to make informed decisions regarding amplification, therapy, or further assessment. Furthermore, the presence of shared outcome frameworks helps prevent unnecessary procedures, particularly in fee-for-service models, and promotes equitable service delivery across different healthcare sectors (Bagatto et al., 2011; Joint Committee on Infant Hearing, 2019; Moeller et al., 2013).

However, without standardized protocols, outcomes often vary not only across regions but even within the same clinical setting (Grol & Grimshaw, 2003). This variability can lead to inconsistent care, inefficiencies, and unequal

access to services—particularly in systems with fee-for-service models. The absence of standardized outcome measures limits the ability to evaluate national performance and compare results across settings, undermining evidence-based decision-making. Moreover, the absence of shared frameworks limits opportunities for performance benchmarking, research, and national-level policy development.

This conceptual review paper examines the current landscape of pediatric audiology outcome measurement practices across Malaysia's public and private healthcare sectors, drawing on stakeholder insights from a national forum to identify standardization challenges and propose strategic recommendations. The review first establishes the current landscape of outcome measures across public and private sectors, benchmarked against international practices, and identifies key gaps. It then examines implementation challenges and potential solutions for bridging these gaps. Finally, it presents a three-phase framework for developing standardized guidelines, encompassing foundation building, guideline development, and sustainability considerations for clinical practice.

## METHODS

This conceptual review synthesizes findings from three complementary processes: (1) expert panel and stakeholder consultation, (2) literature integration and validation, and (3) practice assessment and triangulation.

### Expert Panel and Stakeholder Consultation

Expert insights from a structured panel discussion at the Seventh Malaysian Audiology Scientific Conference (MASCO) forum held in May 2025, titled "Measuring Impact: Assessing the Effectiveness of Evidence-Based Interventions in Clinical Settings for Pediatric Patients in Malaysia." The forum convened a structured expert panel comprising three key stakeholders: (1) a representative from the government sector providing insights into public healthcare practices and policy frameworks, (2) a private sector representative sharing current practices from major audiology centers and case studies from various private facilities, and (3) an international expert (President of the British Society of Audiology [BSA]) offering comparative perspectives on international guidelines and best practices. The panel discussion was facilitated by a moderator using semi-structured questioning to systematically explore current practices, implementation challenges, standardization gaps, and strategic recommendations. Additional insights were gathered through structured question-and-answer sessions with around 180 forum participants representing public and private sectors, including input from local and international invited conference speakers. All expert panel discussions and participant feedback were documented through detailed transcription.

### Literature Integration and Validation

Following the forum, a systematic harmonization process was conducted to synthesize insights from panel and forum participants with supporting evidence from relevant literature. Published guidelines from the BSA, American Speech-Language-Hearing Association, and equivalent professional bodies were reviewed to validate and contextualize expert opinions within established frameworks.

### Practice Assessment and Triangulation

Current practice patterns were assessed through triangulation of panel insights, existing standard operating procedures (SOPs) from public and private sectors, and facility-based case studies presented during the forum. Additional validation was obtained through review of Ministry of Health (MOH) policy documents and equipment procurement reports. Multiple data sources were integrated to identify convergent themes and evidence gaps, supplementing expert insights with documented practices and policy frameworks to ensure comprehensive coverage of the Malaysian pediatric audiology landscape.

## CURRENT LANDSCAPE OF OUTCOME MEASURES

Outcome measurement practices in pediatric audiology across Malaysia reflect the diversity of healthcare provision models, available

resources, and institutional mandates. A review of current tools highlights significant variation in the types and consistency of assessments conducted across different sectors.

## Public Sector (MOH, Malaysia)

In government-run healthcare facilities under the MOH, audiological services are guided by selected SOPs, particularly those for cochlear implantation (CI) and pediatric audiology services. Commonly used clinic- or laboratory-based assessment tools include ABR, auditory steady-state response (ASSR), VRA, play audiometry, cortical auditory evoked potentials (CAEP), and real-ear measurements (REM) for hearing aid verification. These tests are complemented by subjective perception measures completed by parents, such as the LittlEARS auditory questionnaire, parents' evaluation of aural/oral performance of children (PEACH), meaningful auditory integration scale (MAIS), and meaningful use of speech scale (MUSS). Teacher-reported tools like the teacher evaluation of aural/oral performance of children (TEACH) and the screening instrument for targeting educational risk (SIFTER) are also utilized. For older children, self-assessment tools measuring listening effort and auditory function are occasionally employed. Speech perception assessments such as the evaluating auditory responses to speech (EARS) protocol and the ling six sound test are also in use.

In 2024, the MOH received a substantial financial boost of RM10 million for equipment upgrades, leading to the acquisition of 124 otoacoustic emission units, 38 automated auditory brainstem response (AABR) systems, 19 ABR/auditory steady-state response (ASSR) systems, and 10 real-ear measurement (REM) devices (Ministry of Health Malaysia, 2024). This investment represents a significant step toward expanding access to standardized outcome tools and improving hearing aid fitting practices in public sector clinics.

The MOH has also developed foundational documents to guide service delivery. These include the Cochlear Implant Service Operational Policy (Ministry of Health Malaysia, 2017), Guidelines for Neonatal Hearing Screening (Ministry of Health Malaysia, 2022), and Prosedur Operasi Standard Perkhidmatan Audiologi Pediatrik KKM (Ministry of Health Malaysia, 2023). A summary of current outcome measures and established guidelines is presented in Table 1.

## Private Sector

Audiology services in the private sector demonstrate even greater variability in outcome measurements. Data obtained from major private hospitals in Klang Valley, as well as Penang and Johor, such as Gleneagles Kuala Lumpur, Loh Guan Lye Specialist Centre, Prince Court Medical Centre (PCMC), and Private health care center in Johor, reveal a wide range of protocols and tools. The selection of tools is often influenced by the financial capacity of the center, the availability of specialized staff, and commercial priorities. Smaller hospitals do not get many pediatric referrals, hence limited services to offer.

While subjective tools such as LittlEARS, MAIS, and PEACH are in use, there is

**Table 1 Diagnostic tools and outcome measures in the Malaysian public sector**

| Category | Tools/measures |
|---|---|
| Diagnostic pediatric assessment[a] | ABR, ASSR, VRA, Play Audiometry, CAEP |
| Outcome measures (objective) | Aided CAEP, REM |
| Outcome measures (subjective: parents) | LittlEARS, PEACH, MAIS, MUSS |
| Outcome measures (subjective: teachers) | TEACH, SIFTER |
| Outcome measures (subjective: self) | Self-evaluation tools for listening function (older children) |
| Speech perception measures | EARS, Ling Six Sound Test |
| Established guidelines | SOP for Pediatric Audiology (MOH), National Cochlear Implant Guideline (MOH), Guidelines for Neonatal Hearing Screening |

[a]Diagnostic pediatric assessment tools are primarily used for the identification of hearing loss, but may also serve as outcome measures when applied in aided conditions or within a pre–post intervention framework to demonstrate benefit.

**Table 2 Example of variation of protocols, diagnostic tools, and outcome measures between different private audiology centers**

| Medical centers | NHS protocol | Diagnostic pediatric assessment | Outcome measures (objective) | Outcome measures (subjective) |
|---|---|---|---|---|
| Loh Guan Lye (Penang) | 1st test: DPOAE<br>2nd test: AABR | ABR (clicks, chirp)<br>ASSR<br>VRA<br>Play Audiometry<br>OAE | Aided<br>REM | Closed Set<br>Sentence Test |
| Gleneagles KL | AABR: Well babies and NICU | ABR (clicks, CE-chirp, tone burst, Frequency Specific Level Specific CE Chirp)<br>ASSR<br>VRA<br>Play Audiometry<br>OAE | Aided<br>Speech in noise test (SIN: QuickSIN)<br>REM: in the process | LittlEars |
| Prince Court Medical Centre | AABR: Well babies and NICU | ABR (clicks, tone burst, Frequency Specific Level Specific chirp)<br>ASSR<br>VRA<br>Play Audiometry<br>OAE | Aided<br>SpeechMap<br>SIN (Bamford-Kowal-Bench [BKB-SIN], Quick-SIN)<br>CAEP-in the process | LittlEars<br>MAIS<br>PEACH |
| Subang Jaya Medical Centre | AABR: Well babies and NICU | ABR (clicks, tone burst)<br>ASSR<br>VRA<br>Play Audiometry | Aided | LittlEars<br>6 'Ling' sounds |
| Private healthcare centre in Johor | AABR: Well babies and NICU | ABR (clicks, chirp)<br>ASSR<br>VRA<br>Play Audiometry<br>Distortion Product Otoacoustic Emission (DPOAE) | Aided | 6 'Ling' sounds |

Note: Certain tools (e.g., ABR, ASSR, PTA, VRA, play audiometry) are primarily diagnostic in nature, but can also serve as outcome measures when applied in aided conditions or within a pre–post intervention framework to demonstrate benefit.

currently no standardized protocol that mandates or recommends their usage. This lack of standardization presents challenges in achieving consistent care quality across different institutions. Table 2 summarizes tool usage variation across major private providers.

## International Practice

Globally, outcome measurement in pediatric audiology is increasingly supported within national clinical guidelines and early intervention frameworks. Objective and subjective tools—such as CAEP, REM, and caregiver-reported questionnaires like PEACH and LittlEARS—are commonly used to support clinical decision-making and monitor intervention outcomes. In countries like the United Kingdom and Australia, outcome measures are emphasized through structured early hearing detection and intervention (EHDI) programs and national protocols. These frameworks demonstrate

how standardized tools contribute to service consistency, clinical quality assurance, and equitable access to care (Sharma et al., 2022).

International professional bodies such as the BSA and American Speech-Language-Hearing Association (ASHA) have developed comprehensive guidelines to support pediatric audiology practices. These guidelines emphasize early detection, timely intervention, and ongoing monitoring of auditory function using both objective (e.g., ABR, OAE, CAEP) and behavioral tools (e.g., VRA, CPA), along with caregiver-reported outcomes. The BSA provides detailed procedural documents addressing audiological assessment pathways for infants referred from newborn screening, visual reinforcement audiometry setup, aural impression taking, and specific protocols for managing conditions like auditory neuropathy spectrum disorder (ANSD) and pediatric tinnitus (BSA: pediatric audiology resources). Furthermore, BSA guidelines emphasize quality standards, minimum training requirements for professionals conducting pediatric assessments, and the importance of collaborative, family-centered care. These documents not only guide clinical practice but also promote equity, safety, and consistency across services. ASHA's guidance is structured around the EHDI model, with screening, evaluation, and intervention benchmarks set at 1, 3, and 6 months, respectively (ASHA: resource guide for educational/pediatric audiologists). ASHA also highlights culturally sensitive practice, hearing aid fitting principles tailored for children, and collaboration in educational settings through Individualized Education Programs (IEPs).

Together, these international frameworks prioritize safety, consistency, cultural responsiveness, and multidisciplinary teamwork—providing a strong benchmark for Malaysia in formulating its own national guidelines for pediatric outcome measures.

### Identified Gaps

Based on an analysis of Malaysia's current pediatric audiology landscape, several critical observations emerge.

#### *SIGNIFICANT VARIABILITY AND RESOURCE DISPARITIES*

Public and private sectors demonstrate substantial differences in outcome measure selection and assessment protocols, with access to advanced tools like REM, CAEP, and comprehensive speech perception assessments remaining concentrated in specialized centers despite the 2024 MOH equipment investment.

#### *ABSENCE OF UNIFIED PRACTICE STANDARDS*

There is no standardized framework specifying which outcome measures should be used for different patient populations, intervention types, or clinical settings, nor minimum standards governing assessment frequency, timing, and comprehensiveness across facilities.

#### *NEED FOR TIERED IMPLEMENTATION APPROACHES*

Current practices do not account for varying levels of resources, equipment, and expertise across different healthcare facilities, requiring frameworks that maintain quality while accommodating different resource levels.

#### *INADEQUATE INTER-FACILITY COMPARISON CAPABILITIES*

The absence of standardized tools and protocols makes it difficult to compare outcomes across different healthcare facilities, limiting opportunities for quality improvement and benchmarking.

## BRIDGING THE GAP: REAL-WORLD IMPLEMENTATION AND CHALLENGES

Despite Malaysia's steady progress in developing pediatric audiology services, the implementation of standardized outcome measures across the public and private sectors remains fragmented. Disparities are particularly evident in access to advanced diagnostic tools, availability of training, and policy support between tertiary centers and community-based facilities.

### Public Sector Gaps and Progress

Within the MOH Malaysia, approximately 200 audiologists serve in 50 hospitals nationwide,

including two national institutions, two women and children's hospitals, 14 state hospitals, and 42 major and minor hospitals (Ministry of Health Malaysia, 2024). However, access to advanced tools—such as REM, CAEP, and pediatric speech perception assessments—remains limited outside specialized CI centers.

A notable development occurred in 2024, when the MOH received a RM10 million investment, enabling the acquisition of 124 otoacoustic emission (OAE) units, 38 automated ABR (AABR) systems, 19 ABR/ASSR systems, and 10 REM devices (Ministry of Health Malaysia, 2024). While this investment has helped reduce infrastructure gaps, most REM systems are still concentrated in CI hospitals, limiting access for rural and district facilities.

Additionally, inconsistencies in clinical infrastructure—such as sound-treated rooms and modern equipment—further complicate the standardization of outcome protocols. Although the MOH Health White Paper (2023) advocates for a stronger shift toward primary healthcare and prevention, real-world implementation continues to be challenged by limited training opportunities for outcome-based procedures such as aided CAEP, real-ear aided response (REAR), and pediatric speech audiometry.

## Challenges in the Private Sector

The private sector, which comprises roughly 58% of the national audiology workforce (Malaysia Audiology Workforce Survey, 2024), faces similar challenges—with added constraints. Audiologists in private hospitals and Audiology centers often share consultation spaces or must justify costly equipment purchases to administrators unfamiliar with audiological procedures. In many cases, limited funding and a lack of institutional support—especially in practices not affiliated with academic institutions—lead to uneven access to advanced testing.

Advocating for clinical upgrades or standardized procedures in private settings often depends on the audiologist's internal influence and ability to demonstrate service quality. For example, obtaining guarantee letters (insurance) allowing direct referrals to specialists without going through a general practitioner requires negotiation and leadership engagement with the respective insurance agencies. (Darleena Abdul Aziz, personal communication, May 18, 2025). With the registration of Audiologists under the Allied Health Professions Act and having a practicing certificate, more agencies recognize the role of audiologists in providing services.

## International Example: Primary Care Integration in Wales

The Welsh Primary Care Audiology Pathway is a model of integrating audiology services into the primary healthcare system, enabling patients to access assessment and intervention at the first point of care. This model was selected for comparison based on: (1) similar challenges in bridging specialist-primary care service gaps, (2) comparable resource distribution issues between urban and rural settings, (3) demonstrated success in standardizing audiology services across diverse healthcare settings, and (4) policy frameworks with elements transferable to Malaysia's mixed public-private healthcare structure.

In practice, Wales has successfully embedded some audiology services within the primary healthcare system. Rather than confining audiology to tertiary or specialist centers, the Welsh Primary Care Audiology Pathway enables patients to access comprehensive hearing assessments, hearing aid services, and tinnitus support directly at the primary care level.

This model has led to notable improvements in efficiency and access: 87% of cases are managed within the audiology department, only 5% require GP consultation, and just 3% are referred to ENT—figures that have remained consistent over time (Loescher, Allum & Phillips, 2022). Embedding audiology in primary care has also supported the standardization of services, including the standardization of pediatric outcome measures, through unified clinical pathways, clearer referral criteria, and stronger continuity of care.

For Malaysia, which is currently piloting audiology services at Klinik Kesihatan, the

Welsh experience offers valuable insight into how structural integration can enhance access, accountability, and the consistent use of pediatric outcome measures—an area that remains a pressing gap in current practice.

### Advancing Standardization Through Objective Pediatric Audiology Testing

Objective testing plays a critical role in supporting the standardization of pediatric audiology outcome measures, particularly in contexts where behavioral methods may be unreliable or developmentally inappropriate. Among available tools such as OAE and ABR, CAEP offers unique value by providing evidence of auditory pathway activation at the cortical level, thereby linking device use with higher-order auditory processing. This capacity makes CAEP particularly useful for children with ANSD or cases where ABR is absent but cortical responses are still recordable (British Society of Audiology, 2022).

Evidence from the United Kingdom shows that incorporating CAEP testing within standardized clinical pathways has reduced the age of hearing aid fitting and CI referral, contributing to more consistent monitoring of intervention outcomes (Mehta et al., 2017). However, CAEP interpretation requires careful consideration due to waveform variability, emphasizing the need for repeat measures and clinician training to ensure reliability.

In Malaysia, CAEP equipment is currently limited to a few tertiary centers, with significant costs associated with procurement, training, and maintenance. Within a tiered service delivery system, this technology should therefore be positioned as a specialized verification tool at tertiary hospitals rather than a universal screening device. Its use can help establish benchmark data, refine referral criteria, and guide clinical decision-making in complex pediatric cases, thereby anchoring outcome measurement within a more standardized, objective framework. As funding and training capacity expand, gradual integration into broader pediatric protocols could strengthen national efforts toward consistent and accountable audiology outcomes.

### Moving Forward

In conclusion, Malaysia's pediatric audiology landscape stands at a critical juncture. While infrastructure upgrades and workforce development are advancing, the lack of standardized outcome measures—especially in primary care and private sector contexts—risks perpetuating inequities in service delivery. International models such as the Welsh integration of primary care services and the adoption of CAEP in the United Kingdom demonstrate how structural and technological strategies can converge to support standardization. Drawing on international models, Malaysia must now prioritize investments in training, policy support, and intersectoral coordination to bridge the gap between aspiration and implementation.

## TOWARD STANDARDIZED GUIDELINES: KEY CONSIDERATIONS FOR CLINICAL PRACTICE

Developing standardized national guidelines for pediatric audiology in Malaysia is a vital step toward ensuring consistent, equitable, and outcome-driven care across diverse clinical settings. Achieving this goal requires more than adopting international models—it calls for a context-specific framework that acknowledges Malaysia's healthcare infrastructure, cultural landscape, and audiology workforce dynamics.

Drawing from the insights of the national forum, we propose a three-phase roadmap to guide the development and implementation of standardized outcome guidelines: (1) foundation, (2) development, and (3) sustainability. Each phase outlines critical considerations needed to build a robust, inclusive, and adaptable national standard (summarized in Fig. 1).

### Phase 1: Foundation: Building the Right Structures

#### STRENGTHENING STAKEHOLDER COORDINATION

An effective guideline framework begins with an active and continuous engagement among key stakeholders. Coordination must be established among the Technical Committee, which

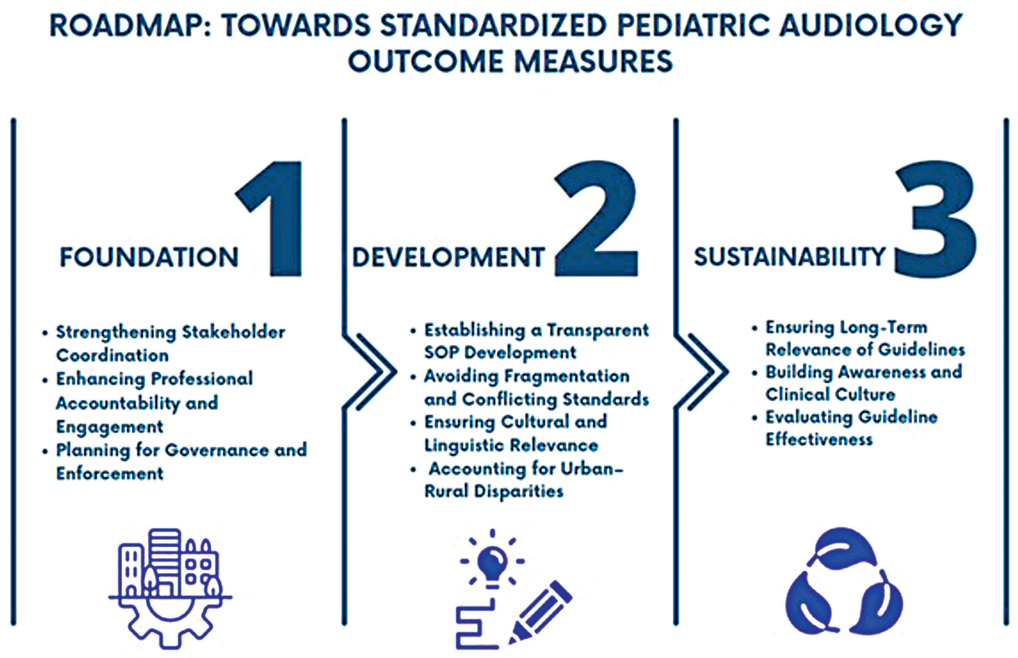


**Figure 1** Road map toward standardized audiology outcome measures in Malaysia.

should consist of professional organizations such as the Malaysian National Society of Audiologists (MANSA), the government health agencies including the Ministry of Health Malaysia, academic institutions, and frontline healthcare providers across public and private sectors. By bringing these diverse groups together early in the process, we can ensure alignment on core principles, avoid duplication of efforts, and establish clear roles and responsibilities. This cross-sector collaboration is essential to developing guidelines that are applicable and implementable across all healthcare settings—public, private, rural, and urban—thereby achieving true standardization. Strong stakeholder engagement from the outset also helps build consensus and buy-in, which are critical for the successful adoption and adherence to standardized guidelines in clinical practice.

### ENHANCING PROFESSIONAL ACCOUNTABILITY AND ENGAGEMENT

The sustainability of any national guideline depends on the active participation of audiologists. This includes formal registration with the Allied Health Professions Council as well as obtaining their practicing certificates and engagement with associations that serve as collective voices for advocacy and reform. However, a recurring challenge lies in mobilizing practitioners to contribute to committee work and guideline development. Without broad-based engagement, even well-designed policies risk limited implementation.

### PLANNING FOR GOVERNANCE AND ENFORCEMENT

Enforcement of clinical guidelines must be supported by policy infrastructure. Within the Allied Health Professions (AHP) Council, existing committees—such as those overseeing Ethics and Practice, Program Standards, Technical Review, and Professional Qualifications—will ensure that the bare minimum will be practiced and regulated, irrespective of place of practice. Once the transitional phase for registration has passed, the role of the enforcement committee will take force to safeguard the profession by ensuring clinical guidance translates into practice with integrity and accountability. This governance structure is essential for

maintaining consistency and compliance with the unified guidelines across all healthcare sectors.

Apart from the AHP Council, hospitals (government and private) usually apply for the Malaysian Society for Quality in Health (MSQH) accreditation program. Recognized nationally and internationally, the program promotes and improves safety as well as quality in the provision of healthcare services in Malaysia. Audiology standards have already been developed under section 17E (Malaysian Society for Quality in Health, 2022). However, a critical gap exists in Indicator 03, which measures intervention success through standardized outcome measures. Currently, this indicator focuses on measuring "percentage of patients showing improved hearing ability within 3 months after hearing aid fitting" using the Client Oriented Scale of Improvement (COSI)—a tool designed specifically for adult populations (age 19 and above). While COSI effectively measures benefit, satisfaction, and rehabilitation outcomes in adults, there is no equivalent standardized pediatric outcome measure within MSQH standards. This absence highlights the urgent need for unified pediatric audiology guidelines that include age-appropriate outcome measures to assess intervention success in children. Together, the AHP Council's regulatory enforcement and MSQH's institutional quality standards create a dual governance framework that ensures unified pediatric audiology guidelines are both mandated for practitioners and embedded in hospital accreditation requirements.

## Phase 2: Development: Creating Fit-for-Purpose Guidelines

### ESTABLISHING A TRANSPARENT SOP DEVELOPMENT FRAMEWORK

A clear and systematic approach to developing SOPs may be beneficial for Malaysia as it moves toward national harmonization. Models such as the BSA's multi-stage guidance process—which includes defining scope, engaging stakeholders, piloting drafts, and conducting periodic updates—offer useful reference points (British Society of Audiology, 2022). Given the relatively small size of Malaysia's audiology community, clarifying roles and responsibilities could help reduce overlap and enhance focus across committees. Establishing a coordinated scoping mechanism may also support alignment between local SOPs and national standards, while minimizing redundancy and ensuring relevance across service settings.

### AVOIDING FRAGMENTATION AND CONFLICTING STANDARDS

To avoid duplication and fragmentation, Malaysia must prioritize unified guideline development. A cautionary example can be drawn from the differences between the BSA and British Columbia's ABR protocols (Hatton, Van Maanen & Stapells, 2022; British Society of Audiology, 2025). Variations in test frequencies, response thresholds, and criteria for absent responses can lead to inconsistent interpretation and compromised patient care. Standardizing national practice will reduce such variability and promote clinical confidence.

### ENSURING CULTURAL AND LINGUISTIC RELEVANCE

Malaysia's multicultural and multilingual society requires that outcome tools and guidelines be adapted to local linguistic and cultural contexts. This includes translating instruments into both Malay and Malaysian English and later into other languages, which are also used by the vast majority of Malaysia (such as Tamil and Mandarin languages), and ensuring that normative data reflect the local population's communication norms and developmental patterns.

### ACCOUNTING FOR URBAN–RURAL DISPARITIES

Lastly, standardized guidelines must consider geographic disparities. Rural centers may not have access to the same equipment or staff training as urban hospitals. Therefore, tiered recommendations or minimum practice benchmarks may be necessary to ensure equitable implementation without compromising quality. Also, less stringent guidelines should be developed for the rural areas, by taking into consideration the capacity of manpower and also logistic issues.

### Phase 3: Sustainability: Ensuring Relevance and Impact

#### ENSURING LONG-TERM RELEVANCE OF GUIDELINES

Malaysia must avoid the pitfalls experienced in other countries where well-intentioned guidelines become obsolete due to a lack of updates or monitoring. Guidelines must be revisited periodically and supported by infrastructure to remain relevant as service demands, technologies, and workforce capacity evolve.

#### BUILDING AWARENESS AND CLINICAL CULTURE

Raising awareness among audiologists about the importance of standardized, ethical, and outcome-based practice is crucial. Guidelines should not be seen as administrative burdens but as a means to protect patients, improve service quality, and ensure standardized services for all, across populations. Professional development programs and university curricula should emphasize the value of adherence to national SOPs and critical thinking about guideline use in daily practice.

#### EVALUATING GUIDELINE EFFECTIVENESS

Guidelines must be assessed for both clinical validity and contextual suitability. Metrics such as diagnostic yield, error rates, functional outcomes, and service utilization should be tracked depending on the clinical application being monitored. The GRADE framework (Grading of Recommendations Assessment, Development and Evaluation) may be used to appraise the strength and clarity of recommendations (Guyatt, Oxman, Vist, Kunz, Falck-Ytter, Alonso-Coello & Schünemann, 2008). Additionally, feedback from a range of key stakeholders, including those in a variety of settings, is essential to gauge the feasibility and adaptability of each standard.

## CONCLUSION

This conceptual review paper has outlined the current state of pediatric audiology outcome measurement in Malaysia, revealing substantial variability across public and private sectors. While recent investments in equipment and the presence of foundational SOPs signal progress, challenges remain in the areas of training, implementation, and equitable access—particularly at the primary care level. Lessons from international models, such as the integration of audiology services in primary healthcare in Wales and the structured use of outcome tools in countries like the United States and the United Kingdom, demonstrate how standardized approaches can improve both service quality and system accountability. In Malaysia, however, the lack of cohesive national guidance risks perpetuating fragmented practices and unequal patient outcomes.

To address this, the formation of a national task force is recommended. This task force should consist of key stakeholders, including the MOH, AHP Council, professional society, academic institutions, and service providers from both public and private sectors. Formation of the national task force could lead to the development, coordination, and periodic review of standardized outcome guidelines suited to Malaysia's diverse service settings. With collaborative leadership, structured governance, and culturally adapted tools, Audiology professionals in Malaysia could build a unified, sustainable framework for pediatric audiology that ensures measurable, equitable, and child-centered outcomes across the country.

## FUTURE CONSIDERATIONS

While this review focused on current standardization challenges, it is important to acknowledge that certain specialized areas of pediatric audiology—including outcome measures for pediatric tinnitus, vestibular dysfunction, and Central Auditory Processing Disorder (CAPD)—require future research and development. These areas, while essential for comprehensive auditory and communicative assessment, currently have limited evidence base in the Malaysian context and warrant dedicated investigation as the field advances.

CONFLICT OF INTEREST
None declared.

ACKNOWLEDGMENT

The authors would like to thank the participants and speakers of the Seventh Malaysian Audiology Scientific Conference (MASCO) forum 2025 for their valuable insights and contributions to this review.

SHORT BLURB

A unified national guideline for pediatric audiology outcome measures is long overdue in Malaysia. This paper outlines critical gaps, lessons from international models, and a roadmap for building standardized, equitable, and measurable care for children with hearing loss.

AI USE IN MANUSCRIPT

This manuscript was created with the support of artificial intelligence to improve content generation and editing. The authors take full responsibility for the final content, ensuring its accuracy and integrity.

## REFERENCES

American Speech-Language-Hearing Association. Pediatric Audiology Education Resources. ASHA. Accessed June 10, 2025 at: https://www.asha.org/aud/pediatric-ed/

Bagatto, M.P., Moodie, S.T., Seewald, R.C., Bartlett, D.J., Scollie, S.D. (2011). A critical review of audiological outcome measures for infants and children. *Trends Amplif,15*(1):23–33

British Society of Audiology. (2022), "BSA Policies & Procedures: Document Definitions and Production Process." [Online]. Accessed October 16, 2025 at: https://www.thebsa.org.uk/wp-content/uploads/2023/11/BSA-Policies-Procedures-Document-Definitions-and-Production-Process-2023.pdf

British Society of Audiology (BSA). (2022). Recommended Procedure: Cortical Auditory Evoked Potential (CAEP) Testing. Accessed October 16, 2025 at: https://www.thebsa.org.uk

British Society of Audiology. (2022). Recommended Procedure: Cortical Auditory Evoked Potential (CAEP) Testing. Accessed October 16, 2025 at: https://www.thebsa.org.uk/wp-content/uploads/2023/10/OD104-40-BSA-Recommended-Procedure-CAEP.pdf

British Society of Audiology. (2025). ABR testing in babies: Recommended procedure (Version 1). Accessed October 16, 2025 at: https://www.thebsa.org.uk/wp-content/uploads/2025/02/100_ABR-Testing-in-Babies-26-Feb-2025.pdf

British Society of Audiology. (n.d.). Guidance development process [Flowchart]. Accessed June 11, 2025 at: https://www.thebsa.org.uk/resources/

British Society of Audiology. Paediatric Audiology Resources. The BSA. Accessed June 10, 2025. Accessed October 16, 2025 at: https://www.thebsa.org.uk/resource-subject/paediatric-audiology/

British Society of Audiology. Recommended Procedure: Cortical Auditory Evoked Potential (CAEP) Testing. 2022. Accessed October 16, 2025 at: https://www.thebsa.org.uk

European Union of Hearing Aid Acousticians (EUHA). National Reimbursement Policies in Audiology: Belgium. 2023. https://www.euha.org. Centers for Medicare & Medicaid Services. Audiology Billing Guidelines. 2024. Accessed October 16, 2025 at: https://www.cms.gov

Grol, R., Grimshaw, J. (2003). From best evidence to best practice: effective implementation of change in patients' care. *Lancet,362*(9391):1225–1230

Guyatt, G.H., Oxman, A.D., Vist, G.E., et al; GRADE Working Group. (2008). GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ,336*(7650):924–926

Hatton JL, Van Maanen A, Stapells DR. (2022). British Columbia Early Hearing Program: Auditory Brainstem Response (ABR) Protocol. Accessed October 16, 2025 at: http://www.phsa.ca/bc-early-hearing/Documents/ABR_Protocol.pdf

Joint Committee on Infant Hearing. (2019). Year 2019 position statement: Principles and guidelines for early hearing detection and intervention programs. *J Early Hear Detect Interv,4*(2):1–44

Loescher, T., Allum, J., Phillips, N. (2022). Prudent healthcare in practice: integration of audiology services into primary care. *BMJ Open Qual,11*(3): e001884

Malaysian Society for Quality in Health. (2022). Hospital accreditation standards (6th ed.): The performance indicators. Malaysian Society for Quality in Health

Mehta, K., Watkin, P., Baldwin, M., Marriage, J., Mahon, M., Vickers, D. (2017). Role of cortical auditory evoked potentials in reducing the age at hearing aid fitting in children with hearing loss identified by newborn hearing screening. *Trends Hear,21*:2331216517744094

Ministry of Health Malaysia. (2017). Cochlear implant service operational policy. Ministry of Health Malaysia. Accessed October 16, 2025 at: https://www.moh.gov.my/moh/resources/Penerbitan/PErkhidmatan%20Pembedahan%20KKM/Koklea%20Implan/COCHLEAR%20IMPLANT.pdf

Ministry of Health Malaysia. (2022). Guidelines for neonatal hearing screening. Accessed October 16, 2025 at: https://www.moh.gov.my/moh/resources/Penerbitan/PErkhidmatan%20Pembedahan%20KKM/Koklea%20Implan/Guidelines_For_Neonatal_Hearing_Screening.pdf

Ministry of Health Malaysia. (2023). Health White Paper.

Ministry of Health Malaysia. (2023). Prosedur operasi standard perkhidmatan audiologi pediatrik KKM. Accessed October 16, 2025 at: https://anyflip.com/wnboq/cgil/basic. Services Australia. Medicare Benefits Schedule – Allied Health Services under CDM. 2023. Accessed October 16, 2025 at: https://www.servicesaustralia.gov.au

Moeller, M.P., Carr, G., Seaver, L., Stredler-Brown, A., Holzinger, D. (2013). Best practices in family-centered early intervention for children who are deaf or hard of hearing: an international consensus statement. *J Deaf Stud Deaf Educ,18*(4):429–445

Ontario Ministry of Health. (2024). Assistive Devices Program – Cochlear Implants and Hearing Aids. Accessed October 16, 2025 at: https://www.health.gov.on.ca

Sharma, R., Gu, Y., Sinha, K., et al. (2022). An economic evaluation of Australia's newborn hearing screening program: A within-study cost-effectiveness analysis. *Ear Hear,43*(3):972–983