

Early detection of hearing impairment in high-risk neonates: Let's talk about the high-risk registry in the South African context

Risk-based newborn hearing screening has been recommended as an alternative approach by the Joint Committee on Infant Hearing (JCIH) in contexts where universal newborn hearing screening (UNHS) is not yet attainable. However, little evidence exists on the relevant risk factors that can be used to facilitate and enhance this method of screening,^[1] particularly in low- and middle-income countries where the social determinants of health are vastly different to those in developed contexts – and contextualised risk factors are important for successful screening programmes.^[2,3]

In establishing contextually relevant risk factors for hearing impairment, in any context, the current authors argue that it is important to note the differences between the terms 'aetiology' and 'risk factor', where aetiology is related to a cause-and-effect relationship with the presence of a disease-causing agent.^[4] Where such a direct relationship cannot be established between the disease and agent, but a statistical association is present, the term risk factor is used.^[4] This definition suggests that a risk factor increases the chances or probability of the occurrence of a condition, while not all individuals with a risk factor may necessarily present with the condition, whereas the aetiology guarantees the occurrence of the condition. It should therefore be recognised that not all babies presenting with risk factors for hearing impairment may necessarily present with a hearing impairment. In resource-constrained environments, such a distinction in definition is crucial, as resource allocation tends to be risk/benefit based.

There are a number of rationales for the identification and use of risk factors for hearing impairment. These include assisting in identifying children who should undergo audiological assessments in geographical regions where UNHS programmes do not exist,^[5,6] identifying children who require medical and/or audiological monitoring,^[7] facilitating the identification of children who are at risk for auditory neuropathy^[1] and effective primary prevention of disabling conditions, as well as their earlier identification, which allows for timely intervention.^[8] It is for these reasons that audiologists need to interrogate risk rather than aetiology, specifically in a context such as South Africa (SA), which is faced with many challenges that may potentially result in increased risks for hearing impairment. The re-engineering of primary healthcare to have more emphasis on prevention also makes this interrogation timely for the audiology community. Addressing risk at the primary level of prevention is important, as mitigation of risk may influence aetiology, arguably in a positive manner, and lead to early and cost-effective identification of hearing impairment in high-risk neonates.

Currently, audiological literature consists of high-risk registries compiled by the JCIH that have evolved over time, as well as a list adapted by the Health Professions Council of SA^[9] for the SA context. Despite the JCIH high-risk registries being considered applicable internationally, findings from studies by Beswick *et al.*^[10,11] and Kanji and Khoza-Shangase^[12] have shown the need to specifically tailor these to one's context. This highlights the importance of context itself, although it is a neglected risk influencer. In a country such as SA, a context-specific challenge such as the quadruple burden of disease is crucial to consider.

In studies by the present authors that explored risk-based hearing screening within two hospitals in the public healthcare sector in Gauteng Province, SA,^[6,12,13] the need for a clear definition of risk, and the importance of its contextualisation, were raised. One of

these studies included 325 babies who had been admitted to the neonatal intensive care unit, high care and/or kangaroo mother care (KMC) wards.^[14] Among the case history factors recorded in this cohort, 11 were identifiable on the HPCSA (2018) high-risk registry (Table 1). Despite this high occurrence of factors listed as risks for hearing impairment, none of the 93 babies in this cohort returning for diagnostic audiological assessment presented with hearing impairment. This led the authors to further interrogate the definition of risk, and the influences of risk at presentation of hearing impairment. This interrogation cannot be avoided in a resource-constrained context such as SA, where resource allocation has to be justified, and use of those resources accounted for.

Medical and technological advancements have led to more advanced medical care. For example, these advancements have allowed for the survival of preterm neonates. However, despite these advancements, extremely preterm neonates and extremely low birthweight neonates remain at high risk for death and disability.^[15,16] This risk of death and disability may be very different in low- v. high-income countries, which highlights the importance of considerations of the role of context.

Within the SA context, one may argue that the quadruple burden of disease^[17,18] has a significant influence on the types of risk factors associated with hearing impairment. It is around this framework of quadruple burden of disease that the present authors deliberated, and coined the concept of quadruple influence on risk that they introduce in this publication. The authors argue that risk for hearing impairment within the SA context is influenced by four factors. They propose that all four factors should be carefully considered when assessing risk/benefit and when making planning decisions, particularly within the re-engineered primary healthcare model that the SA health department has adopted. This quadruple influence on risk is depicted in Fig. 1.

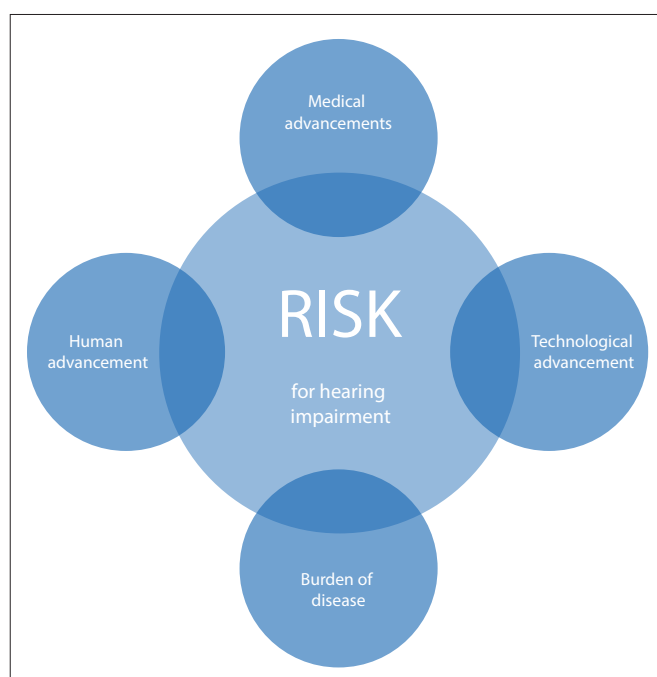


Fig. 1. Quadruple influence on risk.

Table 1. Overview of risk factors for hearing impairment

Risk factor	JCIH (1982)	JCIH (2007)	HPCSA (2007)	HPCSA (2018)	Beswick <i>et al.</i> (2012, 2013)	Kanji (2016)
Caregiver concern regarding speech, language and/or developmental delay		✓	✓	✓		
Professional concern						
Family history of permanent childhood hearing impairment	✓	✓	✓	✓	✓	✓
Findings associated with syndrome known to include sensorineural or permanent conductive hearing loss		✓	✓	✓		✓
Craniofacial anomalies	✓	✓	✓	✓	✓	
Postnatal infections associated with sensorineural hearing impairment		✓	✓	✓		
Head trauma, especially basal skull and temporal bone fractures		✓	✓	✓		
Neurodegenerative disorders		✓	✓	✓		
Syndromes associated with progressive or late-onset hearing impairment		✓	✓	✓	✓	
Chemotherapy		✓		✓		
NICU admission						
>5 days		✓		✓		✓
≥48 hours			✓			✓
Neonatal indicators:						
ECMO		✓	✓			
Hyperbilirubinaemia requiring exchange blood transfusion	✓	✓	✓	✓	✓	✓
Mechanical/assisted ventilation		✓	✓	✓		✓
Exposure to ototoxic medication		✓		✓		✓
Bacterial meningitis	✓				✓	
Severe asphyxia: APGAR scores 0 - 3 and hypotonia persisting to 2 hours of age	✓				✓	
Birthweight <1 500 g	✓				✓	✓
<i>In utero</i> infections:						
Cytomegalovirus	✓	✓	✓	✓		✓
Herpes	✓	✓	✓	✓		
Rubella	✓	✓	✓	✓		✓
Syphilis	✓	✓	✓	✓		
Toxoplasmosis		✓	✓	✓		
Maternal and/or HIV infection			✓	✓		✓
Malaria			✓			
Recurrent or persistent otitis media with effusion for at least 3 months				✓		

JCIH = Joint Committee on Infant Hearing; HSPCA = Health Professions Council of South Africa; NICU = neonatal intensive care unit; ECMO = extracorporeal membrane oxygenation.

The authors argue that medical advancements, technological advancements, burden of disease and human advancements are factors that influence risk for hearing impairment in the SA context. With regard to medical advancements, as an illustration, although prematurity itself may not be a risk indicator, it may be a risk marker, which predisposes the neonate to other medical conditions requiring management. For example, with medical advancements, preterm neonates prone to septic infections may be detected early and treated with aminoglycosides. However, this medical management may have ototoxic side-effects, which place the neonate at risk for hearing impairment.

As far as technology is concerned, screening for hearing impairment in newborns and infants has progressed, with a variety of objective screening measures now available;^[19] this is over and above screening measures for conditions linked to hearing impairment. Technological advancements that influence the identification of medical conditions, as well as their treatments, that impact on hearing function play a significant role in risk definition and its treatment and prioritisation. For example, technological advancements that allow for earlier diagnosis of hyperbilirubinaemia and consequent earlier treatment raise implications for this condition on the risk registry for hearing

impairment. Another example would be the use of ventilation to provide respiratory support in preterm neonates, where the impact of the associated noise levels on hearing function (noise-induced hearing loss) has still not been clearly established. Burden of disease is the third factor influencing the risk for hearing impairment debate. Considerations around burden of disease in any given context ensure that risk factors are contextually relevant and contextually responsive. Within the SA context, exclusion of conditions such as HIV/AIDS and tuberculosis (and their treatments) from any risk debate is foolhardy and irresponsible, particularly when considering the high local incidence of these conditions.^[20]

Lastly, with regard to human advancement, the present authors argue that as humans advance in terms of their levels of education, awareness and interactions, their identification of, response to and reaction to disease and disability play a major role in the risk-factor debate. The authors also propose that human advancement could indicate the greater level of autonomy that those receiving health services have and continue to gain in relation to their own indigenous knowledge systems and beliefs, which may influence health-seeking behaviour within contexts where their culture has been in the minority – the cultural influence on risk. Khoza-Shangase and

Mophosho^[21] argue that ignoring linguistic and cultural influences on the provision of clinical services has a significant impact on the efficacy of the services provided.

It is for the above reasons that the current authors propose careful and continuous deliberations around the quadruple influence on risk factors for hearing impairment. Grounding all academic, research and clinical endeavours in context forces the audiology profession to be relevant, responsive and responsible in all its clinical and academic endeavours. It also forces the profession to be cognisant of the influences of diversity in what is believed and done, and to maximise outcomes within SA healthcare spending at a time of low economic growth and fiscal constraint – that is, doing the best, and being efficient, with the limited resources available. Context allows the profession to directly engage with the social determinants of health in SA, and calls on it to play the advocacy role for patients where these are not optimal. This allows the profession to engage in best practice that is poised for next practice in all its clinical initiatives and endeavours.

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