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Time to Adapt; Need for Contextually Relevant Universal Newborn Hearing Screening

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Time to Adapt; Need for Contextually Relevant Universal Newborn Hearing Screening

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6 AG: Performed experiments, Data analysis, wrote the manuscript

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8 NB: Data analysis, edited the manuscript

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10 AJ: Experimental design, technical expertise, edited the manuscript

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12 PR: technical expertise and edited the manuscript

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14 QA: Data analysis, Technical expertise and wrote the manuscript

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16 YS: Conceptualised study, experimental design, wrote manuscript and supervised
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3 **ABSTRACT: Hearing screening for new-born babies is an established protocol**
4 **in many parts of the developed world. Implementing such screening has yielded**
5 **significant socio-economic advantages at both an individual and societal level,**
6 **which has yet to infiltrate low and middle income countries (LMIC). Here we**
7 **illustrate how the new-born hearing screening program needs to be contextually**
8 **adapted for effective utilisation an implementation in a LMIC. Specifically, this**
9 **advocates the use of auditory brainstem testing at the first-line approach. We**
10 **propose that such adaptation serves to maximise clinical efficacy and**
11 **community participation at a reduced cost.**
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5 **INTRODUCTION:** Newborn hearing screening facilitated a silent revolution for the
6 hearing-impaired yielding significant personal, societal and economic benefits ¹.
7 However, universal screening still faces barriers, namely the need to pragmatically
8 integrate screening with existing health infrastructure, cost considerations and access
9 to healthcare ¹, which are unique depending on the geographical context.

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15 Otoacoustic emissions (OAE) and automated auditory brainstem responses (AABR)
16 have made screening possible, with factors such as cost and training ease being the
17 main consideration when designing a program ^{1,2}. OAE's have historically been cheap
18 and quick but as many as 40% of babies can fail this test requiring referral to
19 specialists for either a repeat OAE or an ABR ³. Technological advances since the
20 advent of screening has seen both the cost-base and time required to perform AABR
21 considerably reduced ⁴ making this an attractive first-line option particularly when the
22 cost of follow-up and poor compliance due to access to healthcare and maternal
23 anxiety are decisive factors.

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32 Accordingly, in settings where early discharge is the norm and access to healthcare is
33 poor, we propose that it may be more effective to screen neonates with AABR as the
34 first-line tool.

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39 **METHODS:** 2269 healthy neonates were recruited from the maternity ward following
40 written parental consent in Amajuba. Babies were generally tested with hours of birth
41 as healthy babies are discharged at 6 hours post- delivery. Testing was always
42 performed in a silent room within the hospital. Ethical approval was obtained from the
43 local research ethics committee (* University of KwaZulu-Natal (UKZN) Biomedical-
44 Research Ethics Committee (BREC: BFC260/16(Sub-study: BFC412/15)).

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51 To assess the auditory brainstem response (ABR) and oto-acoustic emissions (OAE)
52 for each neonate we used the Path-Sentiero®-Advanced-Screener (Landsberger,
53 Germany). For auditory brainstem testing we implemented a chirp stimulus
54 (broadband 1-8kHz) with alternating polarity and a stimulus rate of 85Hz and sound
55 level of 35 dBHL ⁵. For transient OAE, a non-linear broadband click stimulus was
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9 *Patient and Public Involvement statement: After identification of the community's needs, the*
10 *researchers engaged in consultation with the department of health district and hospital*
11 *managers who were in full support of potentially developing a screening programme.*
12 *Patients were not involved in the design of the study as it was incorporated into the existing*
13 *maternal and child health care services.*
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18 **RESULTS:** We observed that in neonates screened with ABR, 2120 babies passed
19 the test, and 149 of the cohort failed the screening. Contrastingly, the OAE test passed
20 only 655 babies in the cohort and failed 1614 babies. Accordingly, for transient OAE,
21 we calculated the following values of sensitivity (87.9%), specificity (30%), positive
22 predictive value (8.11%) and negative predictive value (97.3%).
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28 **DISCUSSION:** Our findings highlight that OAE has a high false positive rate as
29 indicated by its poor specificity. Accordingly, adopting the OAE first protocol in our
30 sample would have resulted in 1465 unnecessary referrals', imparting significant
31 financial burden upon both the individual and the healthcare system as well as
32 considerable anxiety for already disenfranchised parents.
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38 These findings have a wider contextual implication, as healthcare resources across
39 the board are continually being stretched. Thus, a critical spotlight is placed on
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Universal Newborn Hearing Screening in South Africa - a single centre study

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Author Contribution's:

AG: Performed experiments, Data analysis, wrote the manuscript

NB: Data analysis, edited the manuscript

AJ: Experimental design, technical expertise, edited the manuscript

PR: technical expertise and edited the manuscript

QA: Data analysis, Technical expertise and wrote the manuscript

YS: Conceptualised study, experimental design, wrote manuscript and supervised study

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4 **in many high-income countries. Implementing such screening has yielded**
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21 specialists for either a repeat OAE or an ABR ³. Technological advances since the
22 advent of screening have seen both the cost-base and time required to perform AABR
23 considerably reduced⁴ making this an attractive first-line option. Such a proposition is
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21 the test, and 149 of the cohort failed the screening. Contrastingly, the OAE test passed
22 only 655 babies in the cohort and failed 1614 babies. Accordingly, OAE testing would
23 have resulted in most babies needing referral.
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28 **DISCUSSION:** Our findings highlight that adopting the OAE first protocol in our sample
29 would have resulted in 1465 unnecessary referrals, imparting significant financial
30 burden upon both the individual and the healthcare system as well as considerable
31 anxiety for already disenfranchised parents. Although, the cost-base of ABR testing is
32 higher, when factoring in not only the equipment costs but also the costs associated
33 with consumables and maintenance, this can effectively be mitigated against by the
34 volume of avoidable referrals. We thus highlight the need for contextually relevant
35 screening as a prerequisite to effectively engage all stakeholders including the
36 families, government services and clinicians in order for such programs to be deemed
37 viable. Ideally children need to be screened prior to discharge as the birth hospital is
38 the ideal setting to ensure compliance. For a service to be successful in the South
39 African context where early hospital discharge is the norm, screening programs have
40 to adjust to ensure uptake.
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52 These findings have a wider contextual implication, as healthcare resources across
53 the board are continually being stretched. Thus, a critical spotlight is currently being
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