

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

# **IMPLEMENTING A NEWBORN HEARING SCREENING PROGRAMME: A FEASIBILITY STUDY**

A thesis presented in partial fulfillment of the requirements for the degree  
of Master of Arts at Massey University

Karen Anderson-Hawke  
Neonatal Nurse Practitioner™  
2004

## ABSTRACT

**Aim.** To determine the feasibility of implementing a universal newborn hearing screening programme at National Women's Hospital (NWH), Auckland, New Zealand.

**Method.** This feasibility study evaluates the potential for success of a Universal Newborn Hearing Screening (UNHS) Programme in a tertiary hospital setting. A review of the present provision of care for infants with congenital hearing loss and a clear description of the current environment and resources at National Women's Hospital was undertaken. By utilising the four key determinants of a feasibility study as described by Whitten, Bently & Dittman (2001) I was able to provide a clear description of the current position and explore the alternative solutions, ensuring an accurate and comprehensive study approach was undertaken.

**Results.** A detailed analysis of the environmental setting and population at NWH identified the support required for implementing a UNHS programme. Findings also identified the acceptance by both staff and consumers in providing improved congenital hearing loss detection and intervention early in the newborn period. The evidence supported recommendations for two possible hearing screening protocols that are

both practical and feasible in the National Women's Hospital setting for the detection of congenital hearing loss in the newborn population.

**Conclusion.** Overall findings indicated that the implementation of UNHS at National Women's Hospital is feasible. The current method of detecting hearing loss in the newborn population is inadequate with unacceptable delays for diagnosis and appropriate intervention to improve outcomes for those identified with a congenital hearing loss. The protocols supported by this study are based on the research findings and are unique to the NWH environment and target population. They will ensure the infants with congenital hearing loss are detected and referred early (soon after birth) so formal audiological diagnosis and strategies for intervention can occur with treatment implemented by six months of age. This will improve the child's communication and learning skills, improving their level of education and long term learning ability. Further and regular audit of the programme, screeners and outcomes will be required to ensure its efficiency as a screening service for congenital hearing loss.

## **ACKNOWLEDGEMENTS**

I would firstly like to thank my husband for his time and support over the years because without his help this would not have been possible.

I would also like to thank Jill Clendon for her guidance and the unrelenting faith she had in me.

Finally, I would like to thank the friendly and helpful staff at the National Audiology Centre and Auckland University. I shall continue with them in the quest for UNHS for the families and their children of New Zealand.

**TABLE OF CONTENTS**

ABSTRACT.....ii

ACKNOWLEDGEMENTS.....iv

TABLES OF CONTENTS.....v

LIST OF TABLES.....x

LIST OF FIGURES.....xi

**CHAPTER ONE: INTRODUCTION.....3**

    Sensorineural Hearing Loss.....3

    Statement of the Purpose.....8

    Justification.....8

    Outline of the study.....9

**CHAPTER TWO: LITERATURE REVIEW.....11**

    Overview of the Problem.....11

    How the Ear works.....16

    Current Screening Methods.....18

    When to Screen.....22

    Hearing Screening Tools .....26

    Hearing Screening Protocols.....31

False-Positive Screening.....	32
False-Negatives and Auditory Neuropathy.....	34
Duration of the Screening Test.....	35
Where to Screen.....	36
Staff to Screen.....	37
Cost of Screening.....	38
Outcome Measures.....	40
Long-term Benefits.....	42
Maternal/parental Anxiety.....	44
Follow-up.....	45
Ethnic Issues.....	47
Conclusion.....	48

## **CHAPTER THREE: METHOD.....50**

Introduction.....	50
Methodology.....	52
Examples of Feasibility Studies.....	54
Advantages of Feasibility Studies.....	55
Disadvantages of Feasibility studies.....	56
Theoretical Framework.....	57
Design.....	57

The Research Process .....	59
Research Proposal.....	60
Ethics Approval.....	60
Data Collection.....	61
Operational Feasibility.....	61
Technical Feasibility.....	65
Schedule Feasibility.....	69
Economic Feasibility.....	70
Population Demographics.....	72
Business Plan Proposal Review.....	72
Conclusion.....	73

#### **CHAPTER FOUR: RESULTS.....74**

Introduction.....	74
Operational Feasibility.....	74
Technical Feasibility.....	82
Schedule Feasibility.....	91
Economic Feasibility.....	97
Population Demographics.....	102
Conclusion.....	104



**CHAPTER FIVE: BUSINESS PLAN REVIEW.....105**

    Introduction.....105

    Newborn Service Admission Review.....106

**CHAPTER SIX: DISCUSSION.....109**

    Introduction.....109

        Operational Feasibility.....110

        Technical Feasibility.....117

        Schedule Feasibility.....130

        Economic Feasibility.....134

    Conclusion.....136

**CHAPTER SEVEN: CONCLUSION.....140**

    Recommendations.....142

    Protocol 1.....146

    Protocol 2.....148

**GLOSSARY OF TERMS.....154**

**REFERENCES.....155**

**APPENDICES:**

**Appendix 1:** The register of ‘at-risk’ criteria for newborns at risk for  
hearing loss..... 175

**Appendix 2:** Newborn Hearing Screening at National Women’s Hospital  
Business Plan .....176

**Appendix 3:** 1999 National Application for ethical review of innovative  
procedures.....183

**Appendix 4:** Letter of approval from the ethics committee.....193

**Appendix 5:** Consent for Newborn Hearing Screening form..... 194

**Appendix 6.** Correspondence with the New Zealand Nursing Council..195

## LIST OF TABLES

<b>Table 4.1:</b> Ambient noise levels in non-clinical rooms.....	83
<b>Table 4.2:</b> Noise levels detected in Level III, NICU.....	84
<b>Table 4.3:</b> Noise levels detected in Level II, NICU.....	85
<b>Table 4.4:</b> Noise levels detected in PIN, NICU.....	86
<b>Table 4.5:</b> Noise levels detected in incubator verses cot.....	86
<b>Table 4.6:</b> Noise levels detected with acoustic shell.....	87
<b>Table 4.7:</b> Length of Stay, mothers at NWH 2000 and 2003.....	93
<b>Table 4.8:</b> Length of Stay of mothers in January 2004.....	93
<b>Table 4.9:</b> summary of the set up costs for UNHS.....	98
<b>Table 4.10:</b> Summary of the ongoing costs for a UNHS programme screening 7500 babies.....	100
<b>Table 4.11:</b> Summary of the intangible costs.....	101
<b>Table 4.12:</b> summary of the number of Deliveries at NWH and the total number of babies cared for NWH.....	103
<b>Table 5.1:</b> Summary of the NICU admissions NWH.....	107
<b>Table 5.2:</b> Summary of the NICU admissions eligible for Hearing screening .....	108

**LIST OF FIGURES**

**Figure 3.1:** Summary of the four feasibility tests.....58

**Figure 3.2:** Description of the Research Process.....59

**Figure 7.1:** Stage One..... 145

**Figure 7.2:** Screening Protocol One.....147

**Figure 7.3:** Screening Protocol Two.....149

**IMPLEMENTING A NEWBORN HEARING  
SCREENING PROGRAMME:  
A FEASIBILITY STUDY**

*“Among the five senses, people depend on...hearing to provide the primary cues for conducting the basic activities of daily life. At the most basic level...hearing permit(s) people to navigate and to stay orientated within their environment...hearing is a defining element of quality of life” (Snow, 1993, p. 380).*

## CHAPTER ONE-INTRODUCTION

### Sensorineural Hearing Loss

Sensorineural hearing loss (SNHL) affects 3/1000 children per year (White, 1996). In New Zealand there are approximately 60,000 births per year. The 1998 National Audiology Centre database estimates that 2 in every 1000 births have bilateral SNHL and 1 in every 1000 births has unilateral SNHL. That is, 1 in every 330 births will be hearing impaired. These figures equate to the international figures where prevalence of moderate to profound newborn hearing loss has been estimated between 1.5 and 6/1000 live births (Watkin, Baldwin, & McEnery, 1991). The current methods in New Zealand to screen for SNHL only identify approximately half of the children with significant hearing impairment. The majority of these fall in to the 'at risk' group, where hearing assessment is offered to any infant meeting the 'at risk' register criteria (see Appendix 1). Limiting hearing screening of infants with risk factors for deafness only identifies approximately 50% of children with SNHL (Mauk, White, Mortensen, & Behrens, 1991).

Currently in New Zealand most infants with risk factors identified for SNHL are referred to audiology centers for screening and management of hearing loss if detected, though alarmingly the average age of identification is around 23 months of age (Pellow, Blais, & McNeil, 1998). Early detection and intervention for SNHL can impact on long-term outcomes. Hearing is essential for the development of

language and communication skills, development of sensory and perceptual skills, as well as social-emotional growth and academic outcomes (Carney & Moeller, 1998). A financial benefit has also been cited. Mauk and White (1995) note that if early identification and intervention occurs there can be a significant reduction in the cost of special services over the educational career of a hearing impaired child. Hearing loss in infants that remains undiagnosed until early in childhood leads to permanent development delays (Knott, 2001). There is little disagreement that early identification of hearing loss is vital for language, speech and social development during the child's critical period for language acquisition.

Recent evidence supports the concept that the age at which early intervention (e.g. the provision of hearing aids, cochlear implants and therapeutic programmes) is initiated is related to speech and language outcomes. Levitt, McGarr and Geffner (1987) found that children with severe and profound hearing loss who received special education services before 3 years of age had better expressive communication outcomes or intelligible speech than those who began receiving remediation at older ages. More recently studies have reported that infants with hearing loss who were identified and provided with amplification and intervention before the age of 6 months were at a much advanced age level on language tasks compared with infants who were identified after 12 months of age (Apuzzo & Yoshinga-Itano, 1995; Yoshinga-Itano, Sedey, Coulter & Mehl, 1998). Newborn hearing screening programmes have been evolving to provide a more effective achievement of earlier detection of SNHL.



The programmes for early identification of infants with hearing loss in the United States of America (USA) far out-weigh those underway in New Zealand (NZ). SNHL detection in the USA was first supported as early as 1969 with the establishment of the Joint Committee on Infant Hearing (JCIH). Throughout its 33-year history the JCIH has explored the complexities of hearing impairment and its effects on children's development. They have published position statements and recommended preferred practice in the early identification of, and the appropriate intervention with, newborns and infants who are at risk for having a hearing loss. Then in 1994, the JCIH updated its position statement and endorsed the goal of universal detection of hearing loss in newborns and infants as early as possible, while still maintaining the importance of risk factors. In 2000, the JCIH issued an expanded statement that endorsed UNHS, recommending dropping programmes that screened only at risk infants. They called for implementation of early hearing detection and intervention programmes across Northern America.

There is increasing evidence supporting the introduction of universal newborn hearing screening (UNHS) programmes from both the USA and the United Kingdom (UK). Universal newborn hearing screening programmes are now established internationally forming the evidence base that supports a universal approach to detecting SNHL in the well and high-risk populations. The National Institutes of Hearing (NIH) (1993) consensus statement recommends in-hospital hearing screening for all infants admitted to neonatal intensive care units (NICU) and screening of all other infants within the first 3 months of life. One method of

detecting all infants with hearing loss is to use universal screening protocols, a strategy that has been applied in many centers in the USA (Maxon, White, Behrens, & Vohr, 1995). Following this the implementation of such UNHS programmes have escalated throughout the world, providing the resources and strategies that we can now review, learning from their experiences and more specifically, the tools they have used and the protocols formulated.

The European Consensus Development Conference on Neonatal Hearing Screening in Milan in 1998 established that neonatal hearing testing in maternity hospitals was more effective and less expensive than behavioural screening conventionally carried out at 7 to 9 months of age (Grandori & Lutman, 1999). However, what has also emerged over recent years, following the NIH statements and establishment of many UNHS programmes, is the need to provide a more holistic approach to hearing screening. Issues have been identified concerning parental anxiety, screening protocols (including the level of test sensitivity and specificity), follow-up attendance, data-analysis and treatment strategies (Bess & Paradise, 1994; Paradise, 1999). There has also been a concern about the cost, utility and sustainable funding of such a programme resulting in the slow implementation of a universal approach to newborn hearing screening into the New Zealand healthcare system. Therefore it is important to develop cost effective screening strategies that can be universally and easily applied within the context of the New Zealand culture. These issues in a New Zealand context have been explored in more detail to determine an optimal protocol, which would permit infants

with normal hearing to be accurately segregated from those with true-positive results who need extensive follow-up.

A review of the National Womens Hospital (NWH) Newborn Service admissions was undertaken from 1997-1999 to identify the numbers of possible screenings and estimated costs. A proposal and business plan for the implementation of UNHS to undertake an innovative treatment study were developed in collaboration with the National Audiology Centre and University of Auckland Medical School (Audiology Department) by a group called the UNHS development group(see Appendix 2). The proposal identified that the NICU population be the starting point for the screening programme. This was because the NICU constitutes a high proportion of the current audiology referrals from NWH, meeting the 'at risk' referral criteria. Therefore, a staged approach to implementing the hearing screening programme was proposed with the NICU population as Stage One. Identified in the proposal was the need to implement a feasibility study as part of the staged approach to implementing UNHS. This thesis is the feasibility study that was identified as required in the overall implementation plan.

## **Statement of the Purpose**

The purpose of this study was to determine the feasibility of implementing a universal newborn hearing screening programme for all newborn deliveries and admissions at National Womens Hospital, Auckland, New Zealand.

## **Justification**

Universal newborn hearing screening is a well documented and accepted protocol of care for early identification of children with hearing impairment in hospital newborn units and nurseries (Yoshinga-Itano, Coulter & Thompson, 2000; Vohr, Carty, Moore & Letourneau, 1998; Wessex UNHS Trial Group, 1998). The need for a newborn hearing screening programme for deafness in New Zealand, which is more effective than the current 'at-risk' register, is clearly required. As previously mentioned there is now strong evidence from studies in the USA where universal hearing screening has been implemented that early detection and intervention (before 6 months of age) markedly improves receptive and expressive language development, and cognitive skills. This in turn results in better lifelong educational and employment outcomes. Hearing loss in infants remaining undiagnosed until early childhood leads to permanent development delays (Knott, 2001). To significantly reduce the current age of detection and minimise the impact a permanent hearing loss has on a child it is necessary to implement a comprehensive screening programme that will reliably and accurately identify the

presence of a hearing loss in all infants. It is proposed to establish this screening programme at National Womens Hospital with the aim to screen all babies early in the newborn period. It is also anticipated that this programme will provide the information that will lead to guidelines for the development of a national universal hearing screening programme. Universal newborn hearing screening is the ultimate goal and all neonates should be allowed to benefit from early diagnosis and intervention.

### **Outline of Study**

As a Nurse Practitioner <sup>TM</sup> specialising in neonatal intensive and special care of the newborn it is part of my role to have an extensive understanding of the impact of care on the long term outcomes of this unique population. It is clear there is a need for earlier detection of hearing loss in the newborn. This thesis explores the best way to establish earlier detection that is feasible and sustainable. This chapter of the study has provided a background introduction to the thesis establishing the researcher position in this research study.

The second chapter is an extensive literature review on the topic of UNHS, giving a more detailed background to the topic of hearing loss in the newborn, the effects when left undetected and the experiences of established hearing screening programmes internationally. The literature supports hospital based hearing

screening programmes early in the newborn period with appropriate guidelines and protocols implemented to ensure high rates of capture prior to discharge.

Chapter three outlines the methodology used to undertake this feasibility study and has identified the areas unique to the screening environment of National Womens Hospital in the New Zealand context.

Chapter four introduces the data collected to establish the uniqueness of the National Womens Hospital environment and target population. There is little doubt that screening for hearing loss early in the newborn period identifies congenital hearing loss earlier than the current methods of hearing loss detection in practice in Auckland.

Chapter five further discusses the findings of this study identifying key points for consideration in the protocol development.

Chapter six then completes the study with a final indication of the feasibility of implementing a UNHS programme at NWH, Auckland, New Zealand. The thesis concludes with details of the recommendations for protocol development and identifies aspects of UNHS for future research and follow-up.