



HEARING SCREENING FOR EVERY BABY – *A Sound Start:*

**A British Columbia Initiative for
Early Hearing Detection and Intervention**

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(EHDI-BC)
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EXECUTIVE SUMMARY

Each year in British Columbia, approximately 120 babies are born unable to hear the first time their mother calls their name or their father says, "I love you." In virtually every case, parents don't know that their son or daughter can't hear. This is unacceptable and can be avoided. A simple screening tool used soon after birth will accurately identify babies who may be deaf or hard of hearing.

"A Sound Start" is a B.C. initiative to improve the future of deaf and hard of hearing babies and their families. Currently in B.C., hearing loss is identified at the average age of 44 months. By that age, most hearing children have acquired thousands of words and are able to communicate in complete sentences. By contrast, late identification delays access to the needed supports and interventions for deaf or hard of hearing children. This in turn, leads to delayed language and communication development, the key to literacy and academic achievement. Children who have a significant hearing loss cannot acquire language without special help. Without effective language and communication skills, they cannot be expected to learn in school, and they are confronted with limited personal, social and employment opportunities later in life. Delayed detection of hearing loss in infancy prevents early hearing and can compromise early, effective family communication.

Detection of hearing loss and initiation of intervention and support services can be achieved by 6 months of age and, therefore, will maximize opportunities for age-appropriate language development, school readiness and social skills. Newborns with hearing loss can reliably be identified with physiological screening techniques. The universality of this screening is critical because over half of the babies born deaf or hard of hearing do not have any known risk factors for hearing loss. Screening babies at risk for hearing loss (through the use of a questionnaire for hearing risk factors, known as the High Priority Hearing Registry - HPHR) has existed since the early 1970s in BC; however, it has failed to identify children in the first year of life. Most children who are identified in the first year of life through this "screening" have additional disabilities. The children with the highest potential for success are the most likely to be missed in the absence of universal newborn hearing screening.

Accurate hearing screening technologies and protocols are well established, with good sensitivity and specificity in both detecting hearing loss and without burdening assessment services through over-referral. They are objective and straightforward. There is significant evidence that the presence of an infant hearing screening program reduces the age of detection to 3-6 months and that early-identified infants have little, if any, language delay by school entry (Yoshinaga-Itano, 1995, 1998).

A provincial program will provide coordinated, equitable, accessible, and efficient early identification and intervention services for hard of hearing and deaf babies (aged birth to 3 years) and their families. Providing these services in the first three years of life will ensure that families receive the services when they are most needed *and* will lead to the best outcomes. The program will be delivered and managed through existing infrastructures through the Provincial Health Services Authority (PHSA) and the Regional Health Authorities. Partnership and consultation with physicians, families, community agencies, service providers and universities is integral.

The program will span a continuum of services including:

- Birth screening for congenital hearing loss;
- Ongoing surveillance for later onset hearing loss;
- Medical and audiological assessment for confirmation of hearing status;
- Amplification for optimal use of available hearing;
- Early intervention to provide communication development and optimal social-emotional development;
- Public education to increase awareness of the importance of early identification and vigilance;
- Training of service providers; and
- Evaluation including tracking of program outcomes, user evaluation, cost analysis, and program development.

Special education costs for deaf and hard of hearing children are significant. These costs are ongoing due to the sustained delays and gaps that occur in the learning and language of late-identified children. By detecting hearing loss at a young age and initiating appropriate intervention strategies for children with hearing loss, the cost avoidance for intervention and for special education when children enter school with age-appropriate skills, could save B.C. as much as \$2.82M per year by the time the child enters secondary school (calculated from data from Yoshinaga-Itano, 1998).

The human and financial costs to families of late detection cannot be estimated. Early intervention programs have been shown to reduce family stress, improve socio-economic status, lower parental depression and needs, and foster greater resolution of grief (Siegel, 1999). These widespread and long-term benefits have been recognized throughout North America, with universal newborn hearing screening currently in place in all 50 U.S. states and in three Canadian provinces, including Ontario.

The following table summarizes costs of "A Sound Start". Annual operating costs are estimated at \$5.9M by Year 5. Implementation would be phased in over the initial two-year period, with the earliest regional programs being operational within one year. Because the program is being implemented in phases, first year costs of \$5.9M will cover one time equipment purchases of \$3M. Costs dip slightly in years 2, 3, and 4, until year 5 when the full effects of the requirement to follow children for 3 to 4 years is realized. The cost of a "Sound Start" compares favourably with screening and intervention for hyperthyroidism. In addition, the cost per child identified with hearing loss is estimated to be \$48,000, consistent with other established Hearing Screening Programs worldwide.

Summary, EHDI-BC, Budget Estimates June 2004

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	\$	\$	\$	\$	\$
1. a)Screening - Total Number of Babies	23,208	38,135	38,135	38,135	38,135
- Total Operating Cost	\$ 928,320	\$ 1,525,384	\$ 1,525,384	\$ 1,525,384	\$ 1,525,384
b) Screening Equipment Costs & Maintenance	\$ 2,275,000	\$ 455,000	\$ 455,000	\$ 455,000	\$ 455,000
c) Regional Centre Equipment Costs & Maintenance	\$ 703,118	\$ 140,624	\$ 140,624	\$ 140,624	\$ 140,624
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification					
a) Hearing Risk Monitoring:					
- No. of at risk children	1,381	3,650	5,919	6,807	6,807
- Total Cost	\$ 79,439	\$ 190,260	\$ 288,404	\$ 326,820	\$ 326,820
b) Diagnostic					
- Number of Children	696	1,217	1,337	1,384	1,384
- Total Cost	\$ 136,560	\$ 284,082	\$ 373,988	\$ 420,622	\$ 420,622
c) Amplification (Hearing Aid Cost)	\$ 301,855	\$ 496,200	\$ 496,200	\$ 496,200	\$ 496,200
3. Intervention - Total Cases	73	193	313	433	480
- Total Labour Cost	\$ 339,990	\$ 880,943	\$ 1,247,708	\$ 1,442,225	\$ 1,528,810
- Total Materials and Equip.	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000
4. Public/Professional Education	\$ 23,208	\$ 63,135	\$ 38,135	\$ 38,135	\$ 38,135
5. Training	\$ 227,493	\$ 132,496	\$ 132,496	\$ 132,496	\$ 132,496
6. Outcomes and Evaluation	\$ -	\$ 680,000	\$ 70,000	\$ 70,000	\$ 70,000
7. Health Authority Infrastructure Support	\$ 822,487	\$ 793,554	\$ 732,754	\$ 732,754	\$ 732,754
8. Total Program	\$ 5,877,470	\$ 5,681,679	\$ 5,540,693	\$ 5,820,260	\$ 5,906,845

Total Allocation By Health Authority

Health Authority	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	\$	\$	\$	\$	\$
Vancouver Coastal	499,039	655,684	661,151	713,984	761,759
Interior	1,211,896	843,141	847,660	868,278	868,278
North	691,977	578,166	552,333	601,348	613,477
Vancouver Island	1,162,083	806,857	851,716	872,334	872,334
Frasers	1,945,142	1,602,034	1,705,881	1,753,181	1,753,181
PHSA (intervention costs to be regionalized when data available)	367,333	1,195,795	921,953	1,011,135	1,037,817
All	5,877,470	5,681,679	5,540,693	5,820,260	5,906,845

A multidisciplinary provincial group with a broad knowledge base in areas related to infants who are deaf and hard of hearing have informed and guided this proposal development. Audiologists, teachers of the deaf and hard of hearing, parents, physicians, speech-language pathologists and researchers form a strong base for development and implementation of this initiative. Building on existing relationships in the community and bringing together partners, both private and public, will result in a sustainable and coordinated service.

Early detection and intervention for hearing loss is an essential unmet health need in B.C. A provincially funded strategy will result in greatly improved child development outcomes, minimize the amount of intervention needed and provide services in the critical time frame for optimal speech, language, and social-emotional development.

PURPOSE

This document presents a British Columbia initiative for early hearing loss detection and intervention for preschool-aged children and their families (aged birth – 3 years). This proposal presents:

- Background Information, including supporting evidence and the “readiness” for such an initiative
- Program Vision and Principles
- Methods and Technologies of Screening
- Program Description
- Implementation
- Infrastructure and Administration
- Budget (Four-Year Budget, including start-up and average annual cost); and
- Closing

BACKGROUND

When newborns with hearing loss are not identified in the newborn period, the disorder remains “silent” and typically undiagnosed for several years. This is the case currently in British Columbia. The average age of detection varies, depending on the degree of hearing loss, but is typically over 36 months. The most recent provincial statistics indicate that the average age of identification of children with permanent hearing loss in B.C. is 44 months, just prior to Kindergarten entry (see Appendix A: *Age of Detection of Permanent Congenital Hearing Loss (PCHL)*). Intervention after late diagnosis has shown disappointing results in attempting to recover lost ground in development of language/communication, social skills and learning.

It is important at this point to define hearing loss as it applies to this proposal. The term Permanent Congenital Hearing Loss (PCHL) will be frequently used throughout this document. Permanent Congenital Hearing Loss refers to hearing loss of greater than 35 dB HL that is permanent in nature and at any of the important frequencies for speech and language development. Permanent hearing loss includes sensorineural, mixed or structural conductive hearing loss. Important speech frequencies are 500, 1000, 2000 and 4000 Hz.

Provincially, nationally, and internationally there has been mounting public and professional pressure and support to introduce universal newborn hearing screening and early intervention programs. Families are challenging governments that do not provide services that can prevent lifelong disabilities. Families rely on government and service providers to ensure that health care and intervention services provided in B.C. meet accepted and recognized standards of care and best practice.

Internationally accepted technology and standards are now available to identify hearing loss in newborns/infants and to promote good communication development. Similar programs exist or are under development in some provinces in Canada (for example, Quebec, Ontario, Alberta, New Brunswick, Nova Scotia), throughout the U.S., U.K. and Australia.

The Canadian Working Group on Childhood Hearing was established in September 2000 by the Health Surveillance and Epidemiology Division in Health Canada. It was established in response to growing interest in the field of early hearing detection and intervention. Membership on the committee included: representatives of national professional associations; consumers/parents; and experts in otolaryngology, audiology, speech-language pathology, nursing, child health and public health from across Canada. The Group synthesized the data that currently exists surrounding early hearing detection and intervention and brought it together in the form of an evidence-based document useable for individuals in jurisdictions in Canada who are making EHDI policy and programming decisions. The final document is expected to be widely available this Fall. However, much of the evidence presented in this proposal was derived from a draft version of this document.

“A Sound Start” is a timely opportunity for B.C. to improve the standards of care for hard of hearing and deaf babies and their families. There is a wealth of experience both within B.C. and in Canada to draw upon in establishing a provincial program. Ontario launched a provincial program in 2001. Within B.C., VIHA-South implemented universal newborn hearing screening in 2001, and other jurisdictions are attempting to develop initiatives. A provincial strategy will coordinate the small existing regional efforts and ensure that appropriate provincial standards, continuous improvement, evidence based decision-making and accountability guide the program. Strong interest, commitment and enthusiasm are present now amongst services providers and families to develop an innovative program that addresses the needs and diversity of families and settings in B.C.

The low incidence of hearing loss lends itself to a provincial strategy. Small local initiatives working in isolation and without the support of provincial expertise may result in duplication of effort and small sets of data on which to base decisions. A provincial initiative would promote:

- access for all newborns and their families to required early detection and intervention services;
- high quality, consistent and equitable services;
- opportunity to influence the best possible outcomes for children with congenital hearing loss;
- sharing of specific expertise; and
- gathering of standardized local and provincial outcome data for program evaluation and for continuous quality improvement and evidence-based decision-making.

Existing planning efforts through a provincial steering and several provincial working committees are underway (see Appendix B: *EHDI-BC Steering and Working Committees*). The work to date includes consultation with key partners (including representation from each Health Authority), review of the literature, and development of a framework for a provincial strategy. This collaboration between the Health Authorities, University of British Columbia (UBC), service providers and families forms a strong base from which a provincial initiative could be further developed and implemented.

Early detection of hearing loss is now defined as prior to 6 months of age. Research has shown that detection and intervention by 6 months of age is critical in language development. Research supports the existence of critical periods in brain development for the establishment of the auditory and language centres, as well as communication pathways between the brain hemispheres. These critical periods for development occur during the first two years of life and sensory stimulation is necessary for appropriate development. The younger the child when auditory and language stimulation occurs, the better the long-term prognosis for establishment of these centres in the brain. Early sensory deprivation (due to undetected hearing loss and lack of appropriate language stimulation) can lead to long-term negative impact on communication development, despite intensive intervention. The benefits of early detection can be demonstrated from 12 months of age through at least 7 years of age. The quality of nurturing

that children receive in their early years requires that parents and caregivers understand the individual child's needs and that they are equipped with skills to adapt the environment to allow optimal development. Undetected hearing loss is a barrier for parents and caregivers in acquiring the knowledge, skills and opportunities they need to parent effectively. Timely access to supports and services is critical.

There is good evidence that newborn hearing screening leads to earlier detection and treatment (U.S. Preventive Services Task Force, October 2001; Canadian Working Group on Childhood Hearing, 2004). In most of B.C., hearing "screening" is limited to a questionnaire identifying infants at "high-risk" for hearing loss due to perinatal factors. This is called the "High Priority Hearing Registry" (HPHR). Some areas of B.C. have no HPHR available, relying on physician or parent referral.

This HPHR strategy was designed to reduce costs and improve effectiveness by focusing resources on those infants most likely to have hearing loss. This logic is questionable as implementation of the HPHR may be more resource intensive than universal hearing screening programs and result in fewer deaf and hard of hearing children being identified. Research indicates that 50% of the infants born with hearing loss are missed through screening of high-risk infants. High-risk screening has existed in the U.S. for decades. It has failed to identify a large cohort of children in the first year of life. Furthermore, those children who are identified in the first year of life have a significantly higher incidence of secondary disabilities (approximately 66%) than children identified through newborn hearing screening and well-baby nurseries (about 30%). Thus, the children with the highest potential for success are the most likely to be missed without universal newborn hearing screening. Even with the most observant parents, hearing loss is typically not identified until language and speech fail to develop.

Attempts at using other behavioural screens such as "distraction testing" (for example, United Kingdom, Australia, Scandinavia, Germany) continue to report an average age of hearing loss detection between 2 and 2.5 years. Studies of statewide universal newborn hearing screening programs in the United States have found the mean age of detection of hearing loss to be between 3 to 6 months of age.

A developing body of evidence supports better outcomes for early-identified children (prior to age 6 months) compared to later-identified children. There is now a population of early-identified children with significant hearing loss, and their language levels are within the average range when compared with their hearing peers. Prior to infant hearing screening programs, there has not been a "population" of children with significant hearing loss who have achieved average age-appropriate language skills. Universal newborn hearing screening results in earlier treatment. The treatment after detection of hearing loss is typically hearing aid fitting and enrolment in intervention programs for communication and social emotional development.

Permanent Congenital Hearing Loss (PCHL) is a serious public health problem affecting at least 1 to 2 babies in 1000 births, with some studies suggesting as many as 6 babies per 1000. The most comprehensive data available are from the United Kingdom (Fortnum et al., 2001). The prevalence of a moderate degree of hearing loss was found to be approximately 1 per 1000 births. The prevalence triples to approximately 3 per 1000 births (Prieve et al., 2000, Finitzo et al., 1998) when milder and unilateral hearing losses are included (see Appendix A: *Age of Detection of Permanent Congenital Hearing Loss (PCHL)*).

Hearing loss is the inability to hear sounds at normal levels. Sounds, both conversational and environmental, in an infant's environment play a key role in the development of language skills. This

early language development lays the foundation for academic performance, literacy, communication and socialization. The lack of auditory input greatly impacts the developmental potential of these children (Carney & Moeller, 1998).

The typical consequences of hearing loss include significant delays in language development, cognitive, emotional, psychosocial development, and academic achievement. Language development is a prime indicator of future academic success. Delays in all of the aforementioned domains are apparent for both children with mild and moderate hearing loss (Davis et al., 1986) as well as for those who losses fall in the severe and profound ranges (Geers, 1989; Moeller, Osberger, & Eccarius, 1986). Despite advances in hearing aid technology, improved educational techniques, and intensive intervention services, there has been virtually no change in the academic statistics since the systematic collection of American data starting 30 years ago (Yoshinaga-Itano et al., 1998). On the average, deaf students achieve third grade reading achievement and language levels. Hard of hearing students fair slightly better, with sixth grade levels. These limitations in reading have a pervasive negative impact on overall academic achievement. The earlier the hearing loss is identified, and supports and services for communication development are provided, the better the acquisition of language skills (Yoshinaga-Itano, 1998).

Intervention programs are most successful when commenced in the first few months of life and far less successful when implemented after the age of 6 months (Yoshinaga-Itano et al., 1998). When children are identified at a late age and intervention is then necessarily delayed, speech/language and academic achievement is severely limited (Holt 1993; National Institute of Health Consensus Statement '93; Yoshinaga-Itano et al., 1998). However, deaf and hard of hearing children who receive intervention prior to 6 months of age can develop language and learning similar to normal hearing children (Yoshinaga-Itano et al., 1998).

Good health policy results from an interplay of evidence, context and human values. Infants cannot complain of a lack of hearing and cannot seek intervention that adults would seek for themselves. It is incumbent on service providers to ensure that infants have equal opportunities to develop effective communication.

VISION AND PRINCIPLES

The vision of this program is to positively change the future of hard of hearing and deaf children in B.C. A provincial program that focuses on early identification and intervention will allow young children and their families to access the services and supports required for communication development so the children and families will acquire the communication skills critical for positive social development, educational achievement and personal independence.

The program will endorse and operate in accordance with the following principles:

- Use of current research and evidence-based practice principles;
- Provision of a continuum of service delivery components spanning identification, evaluation, intervention, and communication support;
- Delivery of integrated and coordinated service, both locally and provincially;
- Recognition and promotion of Family-Centred Care;
- Sustainability with respect to costs and benefits;
- Accountability; and

- Recognition and support of the geographical and cultural diversity of British Columbia.

Consultation with key partners has guided the development of this proposal and will be an essential part of program development. Key partners include:

- Parents of hard of hearing and deaf children;
- Regional Health Authorities (including Public Health Nursing, Audiology and Speech Pathology Services);
- Early Intervention services for Deaf and Hard of Hearing children and their families (including BC Family Hearing Resource Center, Vancouver Oral Center and Deaf Children's Society)
- Intervention services (Child Development Centres, Infant Development Programs)
- Dispensing Audiologists;
- Physicians;
- Midwives;
- Birthing Hospitals (including Departments of Otolaryngology, Obstetrics and Gynaecology, Paediatrics, Neonatology and Nursing);
- Education (including Teachers of the Deaf and Hard of Hearing, School Districts, Provincial Resource Programs, and Special Needs Programs); and
- Academic researchers (coordinated through UBC) with an interest in hearing disorders.

NEWBORN HEARING SCREENING METHODS AND TECHNOLOGIES

Hearing is screened using automated physiologic measures. The two screening technologies in current widespread use are automated otoacoustic emissions (AOAEs) and automated auditory brainstem response (AABR). Both use automated response detection, providing a PASS/REFER screening result and do not require interpretation by screening personnel, thereby increasing objectivity.

The method chosen depends on a number of factors, including cost, prevalence of hearing loss, degree of hearing loss and type of disorder to be detected. Both types of screening can be completed with portable equipment and can be completed on a quiet baby in under 5 minutes for AOAE and under 20 minutes for AABR. Because of its greater instrumentation expense, slightly greater training requirements, capacity to detect higher level auditory disorders, and better refer rates, AABR screening is commonly reserved for high-risk newborns, or as a second screen in babies who refer from OAE screening. Since the prevalence of hearing loss is higher in Special Care Nursery infants, AABR is the method of choice. AABR screening can detect Auditory Dys-synchrony, an auditory disorder that is missed by AOAE. Approximately 10% of infants with severe to profound hearing loss demonstrate Auditory Dys-synchrony and most cases are found in graduates from Special Care Nursery.

Screening is often completed in two stages. These are referred to as Stage 1 and Stage 2 screening. Stage 1 screening can be considered the "entry" level screening that is used for all babies. A second level or stage of screening can be considered a "higher level" screening that is reserved for babies presenting with a refer result on the "entry" screen.

Each screening method has requirements for optimal results. AOAE screening is best done after 12 hours of age and within the first 4-6 weeks. AABR screening, on the other hand, is best used for infants over 34 weeks gestational age at any time after birth. Both require a quiet baby. AOAE can be done when babies are awake; however, AABR works best with a sleeping baby.

The sensitivity and specificity of screening tests depends on a number of variables, including degree of hearing loss to be identified. For the type of program being proposed for BC, typical sensitivities for AABR are at least 85% and a specificity of 90-95% (Norton et al., 2000; Thompson et al., 2000). Pre-discharge AOA sensitivities are 80-90% and a specificity of 90% (Norton et al., 2000; Thompson et al., 2000). The target refer rate for most newborn hearing screening programs is less than or equal to 4%. This results in an acceptably low over-referral rate to avoid burdening the assessment services and acceptably low under-referral to decrease the cost of failing to detect Permanent Congenital Hearing Loss (PCHL). There is increasing evidence that multistage screening that includes AABR in at least one stage can achieve overall referral rates as low as 1-2%.

PROGRAM DESCRIPTION

“Hearing Screening for Every Baby – A Sound Start: A British Columbia Initiative for Early Hearing Detection and Intervention” is a program that will identify infants with permanent congenital hearing loss and provide follow up management appropriate to the child’s and family’s needs. The program will be delivered and managed through the existing and expanded infrastructures in place in B.C.

“A Sound Start” will be available to all babies in B.C. The budget will cover services from birth to age three years. Existing services will continue to meet the child and family needs in subsequent years. Those babies identified with permanent hearing loss will have access to audiology, amplification and intervention services.

“ A Sound Start” will span a continuum of services including:

- Birth screening for congenital hearing loss (called **Screening**);
- Ongoing surveillance for later onset hearing loss (called **Delayed-Onset Hearing Risk Monitoring**);
- Medical and audiological assessment for confirmation of hearing status (called **Diagnostic Assessment**);
- Amplification for optimal use of available hearing (called **Amplification**);
- Early intervention to provide family support, communication development and optimal social-emotional development (called **Intervention**);
- Public and family education to increase awareness of the importance of early identification and vigilance (called **Public/Professional Education**);
- Training of service providers (called **Training**); and
- Evaluation, including tracking of program outcomes, user evaluation, cost analysis, and program development (called **Outcomes and Evaluation**).

The program will add new service components, expand and link existing services to develop community capacity. Existing services will be required to expand their practice and expertise to successfully serve children who will both enter services at an earlier age and present at that earlier age with a broader range of hearing losses. A short description for each component of “A Sound Start” follows.



Screening:

The purpose of screening is to identify infants:

- who may have PCHL and require further diagnostic assessment to confirm hearing status;
- who are eligible for Delayed-Onset Hearing Risk Monitoring; and
- who have good hearing at birth.

There are several factors that interact in determining specific screening protocols, including wellness of the baby, birthing rate, and location of the hospital. All babies will receive at least two separate screenings, called Stage 1 and Stage 2. Stage 1 screening refers to the initial screening. If passed, screening is complete. Infants referring from Stage 1 screening proceed to Stage 2 screening. If infants pass on Stage 2 screening, screening is complete. If infants refer on Stage 2 screening, then they proceed to Diagnostic Assessment.

The screening will use both AOAE and/or AABR screening methods and will be carried out in two stages. Existing or newly hired screening personnel, including nurses or audiometric technicians, will do hearing screening. All screening personnel will be trained and supervised (on screening related duties) by audiologists in each local area. The screening protocols are designed to identify PCHL. Babies who are missed in hospital and homebirths receive comparable screening in the community.

The screening protocols are determined by presence of risk factors for hearing loss, the size of the birthing hospitals, and access to community screening or hearing diagnostic assessment services. Please see Appendix E: *Decision Making and Supporting Evidence for Screening* for further information.

The screening protocols lead to three main options:

1. Two-stage screening, AOAE and repeat AOAE screening for small hospitals (less than 500 births), babies missed from larger hospitals, homebirths and some rural remote locations;
2. Two-stage screening, AOAE followed by AABR screening for large hospitals (greater than 500 births); and
3. Two-stage screening AABR followed by repeat AABR for Special Care Nursery infants (SCN stay of greater than 48 hours).

Delayed-Onset Hearing Risk Monitoring:

Babies who were successfully screened at birth may exhibit a risk factor for later onset hearing loss, which can significantly impact communication. This hearing loss occurs after the newborn period and is evident in the first 3 years of life.

The purpose of Delayed-Onset Hearing Risk Monitoring is to identify infants who have passed screening and have good hearing at birth, but are at risk for developing hearing loss early in childhood. Depending on the risk factors considered, between 7% - 15% of the newborn population is at risk for delayed-onset hearing loss. There are limited data on the prevalence of delayed-onset hearing loss; however, it is suggested that current prevalence data underestimate progressive and delayed-onset hearing losses (Hyde, 2002). Therefore, a strong surveillance component is crucial to any early hearing detection and intervention program.

The Joint Committee on Infant Hearing Year 2000 Position Statement recommends that infants presenting with indicators for delayed-onset hearing loss should receive audiological monitoring until age 3 years. Risk factors were determined by looking at prevalence ratings for each factor (see Appendix A for a description of prevalence ratings). Delayed-onset hearing risk indicators include:

- Family history of permanent childhood hearing loss;
- Presence or suspicion of a syndrome known to include hearing loss;
- In-utero infections such as cytomegalovirus, herpes, rubella, syphilis and toxoplasmosis;
- Blood exchange transfusion;
- Persistent hypertension of the newborn;
- Conditions requiring the use of ECMO (extracorporeal membrane oxygenation);
- Difficulty breathing, requiring mechanical ventilation;
- Head trauma;
- Post natal infections associated with hearing loss (bacterial meningitis);
- Craniofacial anomalies; and
- Neurodegenerative disorders

Monitoring would be through existing Public Health Audiology clinics. All Health Authorities, except greater Vancouver, have been following a HPHR. Clinics that have been using a HPHR will be able to redirect some resources in support of this component. However, in many regions, Audiology staffing has been insufficient to complete this activity in a timely manner with the recommended frequency of monitoring. Most children receive, at best, one behavioural assessment through the HPHR in the first year of life.

Infants are checked for Delayed-Onset Hearing Risk indicators during the birth admission screening. For Budget purposes, the decision was to include three opportunities for monitoring of young children at risk for delayed-onset hearing loss until three years of age, with an 85% follow-up/access rate. The Screening Committee will be evaluating the factors to be included, implementation, surveillance ages and protocols.

Diagnostic Assessment:

The purpose of diagnostic assessment is to identify the presence of PCHL and to provide an adequate audiological and medical basis for parental consideration of options for intervention and amplification. Informed parent choice requires accurate diagnostic information. Infants identified with PCHL will receive ongoing monitoring of hearing status through existing Public Health Audiology clinics.

Infants seen for diagnostic assessment are referred from Stage 2 screening. Diagnostic assessment has two parts: audiological and medical. Audiological assessment will be provided at the Regional Audiology Centres. Medical Assessment will be provided through local otolaryngologists or through referral to the Otolaryngology Department at BCCH. Other referrals will be initiated as needed.

The protocols for diagnostic assessment must ensure that hearing status is confirmed in time to allow intervention to begin before 6 months of age. Therefore, assessments should be targeted to occur at a corrected age of 8-12 weeks, and in the case of SCN graduates having extended stays in hospital, approximately 2-4 weeks after hospital discharge. This "critical" timing requirement directs the type of assessments that are completed.

Audiological Assessment:

The purpose of audiological assessment is to provide sufficient audiometric information to direct the subsequent events, which may include medical diagnosis and treatment, prognosis, provision amplification, and/or intervention. Children identified with PCHL will receive ongoing monitoring of hearing status through existing Public Health Audiology clinics. Audiologists skilled in testing infants and young children perform these assessments. The objectives are to obtain valid and accurate estimates of ear-specific, frequency-specific thresholds and to determine the nature or type of the hearing loss (conductive, sensorineural, mixed, Auditory Dys-synchrony).

In most babies with a developmental age over 6 months, an accurate behavioural testing of hearing using a conditioned response (for example, a head turn to a sound stimulus) is feasible. These commonly used behavioural audiological assessment protocols, where babies are "trained" or "conditioned" to respond to a variety of calibrated sounds, are simply not appropriate for infants. Therefore, specialized equipment, training and protocols are needed. Once babies are able to "participate" in assessment, behavioural audiological assessment protocols can be used. Both electrophysiologic and behavioural assessments require careful technique and considerable expertise for reliable and valid test results. Well-designed test protocols, adequate training and sufficient caseload to maintain skills are critical.

Audiological assessment refers to detailed determination of the hearing status. For infants, definitive quantification of hearing may require several test sessions, either to improve audiometric completeness, and/or to monitor possible changes in hearing. Audiological assessment needs to be completed by two to three months of age for early identification to occur. In infants less than 6 months of developmental age, electrophysiologic estimation of hearing thresholds is best practice. These methods rely upon the detection of electrical activity in the auditory system. These electrophysiological measures have been proven to be good predictors of "actual" hearing thresholds.

Audiological assessment will be provided at Regional Audiology (referral) Centres in each Health Authority (see Appendix D: *Decision Making and Supporting Evidence for Screening*). This will be done using

frequency-specific ABR measurements of hearing thresholds. Additional training in new methods and interpreting infant results will be required for the Regional Audiology Centres.

Medical Assessment:

Children who are identified with hearing loss require diagnostic medical investigation. These investigations are typically undertaken by an Otolaryngologist and can involve vision testing, blood work, CT Scan and or genetic testing. These tests assist in etiology and genetic counselling for the family and direct patient management.

Amplification:

The goal of amplification is to improve the ability to hear and thereby to facilitate the development of sensory and perceptual skills, receptive and expressive language, speech production and literacy, academic performance and social-emotional growth (Carney & Moeller, 1998). For newborns and infants, the goal is to provide amplification by no later than 6 months of age. Practically, this involves delivering amplified sound (through a hearing aid and a custom made ear piece) to a baby's ear, so that the hearing that the baby has can be used maximally for learning about the surrounding world and developing communication.



To proceed with amplification, babies and families will need to meet specific criteria. These include:

- Confirmed PCHL and expected benefit from amplification;
- No medical contraindications and medical approval has been given by an otolaryngologist;
- Parents are fully informed and adequately understand amplification options, expected benefits, potential harms; and
- Parental consent is given.

Amplification includes the process of selecting a hearing aid, verification that the specified acoustical performance targets have been achieved, and validation of device effectiveness. The prescription includes specification of the type of hearing aid to be fitted, appropriate settings and applications that will result in an amplification system that addresses the needs of the individual infant and family. Infants with amplification will receive ongoing monitoring through the existing Public Health Audiology clinics.

Safety and comfort of the infant are paramount (see Appendix F: *Hearing Aids – Needs for Infants*). Inappropriate diagnostic assessment or fitting of hearing aids can result in harm to infants. Potential

“harm” includes failure to provide the maximum possible improvement in hearing, and further damage to hearing as a result of excessive amplification (Macrae, 1991, 1995). Failure to provide the maximum possible improvement will impact the potential for optimal communicative and developmental benefits of early identification. The EHDI-BC Hearing Devices Committee will be establishing minimal competencies and protocol for this new population of pediatric hearing aid fittings.

Ongoing hearing aid evaluation and monitoring is a frequent and intensive service requirement for babies and their families. Local access to hearing aid services is critical and will be delivered through existing Public Health Audiology clinics and in partnership with other local, and in some cases, private sector service providers.

Hearing aid costs pose a significant, unexpected financial burden for families, oftentimes when the family income is lower due to maternity leave. All other provinces in Canada have some degree of provincial funding for hearing aids for children. Private or workplace extended medical plans provide only minimal reimbursement, typically covering only 10% of the true costs of infant hearing aid costs (most cap at \$400 reimbursement) in B.C. Families in need may seek assistance through charitable organizations; however, the application process often adds delays of several months. This is a barrier to achieving best practice fitting of amplification by 3 months post identification. “A Sound Start” will include the cost of initial hearing aid fitting and associated costs for the first three years to ensure equitable and timely access to this essential component of the program. This will allow families time to plan for future replacement of hearing aids, typically once every 3- 5 years for children.

Due to the low incidence and difficulty predicting where the budget may be needed in any given year, it is proposed that the budget for hearing aids will be retained centrally at PHSA to ensure equitable access as needed. This will also allow for exchanges to a central hearing aid bank in the case of progressive losses or other conditions requiring a change in model. Additionally, infants who may be candidates for cochlear implants require trials with hearing aids as part of the candidacy process. Those hearing aids can be returned to the hearing aid bank if the infant does proceed to implantation, without unduly burdening the family with the full cost of hearing aids for only a short term use.



Intervention:

Babies with PCHL and their families will be enrolled in intervention by 6 months of age. Each family will have a Case Manager who will assist the family through the Intervention process. Intervention will focus on early and successful communication development, family adjustment to PCHL and academic preparedness. As soon as a baby is diagnosed with hearing loss, the Audiologist and family establish a support team consisting of appropriate service providers, as needed. Early in the establishment of this team, a case manager is identified. The role of the case manager is to assist families in navigating through assessment and intervention services, coordinating referrals, providing unbiased information on options for services, and counselling and support. This may be an Audiologist, Speech-Language Pathologist, Teacher of the Deaf and Hard of Hearing, Infant Development Worker, IDP Consultant, Family Support Worker or other professional.

A variety of communication options will be presented to families in an unbiased manner by the case manager. Families may choose some or all, depending on their baby's needs at different points in time. Parents will be informed of the range of services available to support the family and the baby's development.

Typical intervention strategies for hearing loss may include some or all of the following:

- Amplification using hearing aids, sometimes followed by cochlear implantation;
- Parent education related to hearing loss and development, and training of speech, auditory, and language facilitation strategies;
- Family Support;
- Family sign language instruction and
- Speech/language therapy

Intervention programs in B.C. represent a range of services that are available in varying degrees in local areas across the province (see Appendix G: *Inventory of Local and Provincial Outreach Intervention Services*). Specialized provincial programs will offer outreach to families and training for local service providers. Currently, intervention service providers include infant development consultants, speech-language pathologists (located in Child Development Centres, Public Health Units, and in programs specifically designed for preschool children with hearing loss), and teachers of the deaf and hard of

hearing. There will need to be careful review of existing services in each region to build those services for a younger population.

“A Sound Start” helps to link these valuable resources such that when an infant is identified, intervention, education, and support services/strategies will be customized to meet the individual family and child needs in the family’s home community. Community service providers who lack extensive training and experience with infants with hearing loss will receive training and ongoing support.

Children will continue to have the opportunity to receive services directly from the organizations specializing in children with a hearing loss. In all communities, particularly those outside of the Lower Mainland there would be an increased role for IDP consultants in the provision of service to these families. IDP consultants have a strong background working with infants and their parents, and they are very knowledgeable in the area of family support. Ongoing support of communication development would come from direct service of the community speech-language pathologists (SLP’s) working in partnership with the IDP consultants. The SLP’s area of expertise is early communication and listening development, strategies for developing communication, and a background in issues related to hearing loss.

Public/Professional Education:

As this is a new initiative for B.C., “A Sound Start” will implement and support a thorough public/professional education and awareness campaign. It will include information packages for families and professionals, resource catalogue and opportunities for group communication. A strong communication link with these key stakeholders is essential to ensure that current information back and forth is shared. It will also ensure families and professionals have current evidence-based information.

Training:

Training programs will be developed and provided for service providers to ensure that they have the required skills and competencies in screening, assessment, hearing aid fitting and intervention for infants. Most Public Health Audiology Centres have had limited experience with very young infants; however, there are centres in B.C. that have the expertise to deliver training.

One of the major areas for training is diagnostic audiology assessment. UBC has a program for training audiologists and within that program are experts on infant electrophysiologic assessment. The plan is to ask UBC to be a resource for this aspect of training. All audiologists in Regional Audiology Centres will receive initial training and annual training thereafter to ensure knowledge, skills and competency in assessment. UBC will provide expert consultation to assist an audiologist with difficult cases.

A second major area of training is the training of local service providers to provide intervention. There is already a provincial resource in place that provides training to community service providers through outreach programs. The provincial resource will be additionally funded through “A Sound Start” to expand this component of training.

A third major area of training is the fitting of amplification for infants (habilitative audiology). Ontario, through the University of Western Ontario, has expertise in this area. British Columbia has had limited experience with fitting infants, so expertise for this area will need to be imported initially for capacity building. This will require training for audiologists in Regional Audiology Centres and also in some Public

Health Audiology Clinics. This will be determined by caseload and access for families to services that are close to their home.

For training where there is no provincial expertise, experts from across Canada and the United States will be accessed. Because universal newborn hearing screening has been available in the U.S. for at least 10 years and in Ontario for 2 years, expertise is available to draw on.

A resource directory and training guide will be developed by the Provincial Coordinator. Additionally, Regional Coordinators will be in place to assist with difficult cases or access recognized experts. Developing key contact points for service providers will ensure consistency across the program and the development and expansion of local and provincial expertise.

Outcomes and Evaluation:

Efficiency and effectiveness of the program will be measured. Continuous quality improvement for each component will be needed to achieve desired outcomes. At each step in the process of care, performance measures will be undertaken to examine whether the system meets the accepted standards of quality and ensure reporting on performance contracts. There are recognized benchmarks (quantifiable goals or targets) and associated quality indicators (which reflect a result in relation to a stated benchmark) that serve to monitor program effectiveness (delivering appropriate outcomes) and efficiency (quality at lowest cost).

There are approximately 40,140 babies born in B.C. each year. The target for the program is for at least 95% of these babies to have their hearing screened at birth, with follow-up completed for at least 85% of infants referred. The evaluation framework is under development. It will not be possible to monitor or evaluate this program without an Information Technology (IT) solution to record, store and report the data. Each screening site will require computer hardware to facilitate data entry and collection of data.

One option under consideration is the development of a screening module linked to existing audiology data systems, for example, the Public Health Information System (PHIS), which would enable infant data entry and tracking to ensure babies are not missed or lost to follow-up.

A provincial database will incorporate a Provincial Hearing Loss Registry and is required to address the long-term evaluation of the program including outcomes for early-identified infants and their families, and will link with the early childhood development database (Human Early Learning Project) (see Appendix H: *Hearing Loss Registry*). This registry would include all children in B.C. with developmentally significant hearing loss, and would be used to:

- Link the registry with population-based, longitudinal education and health data (EDUDATA and the B.C. Linked Health Database) and
- Track the developmental trajectories of children with hearing loss and their use of intervention services, from birth to adulthood.

Outcome Evaluation includes the assurance that the program attains its goal of school readiness and age-appropriate language development at school entry for the graduates of the EHDI-BC program. Collaboration with research groups, including those involved in child outcome and language data, is

critical to evaluate program performance as a whole, improve program components as needed, and to add to international knowledge in the area of early detection, habilitation, and intervention of children with hearing loss.

Program evaluation will also assist in the forecast of future needs and expenditure reallocation and contribute to the research base.

PROGRAM IMPLEMENTATION

Program implementation will require ongoing involvement of the EHDI-BC provincial steering and working committees. Their broad knowledge base in areas related to infants who are deaf and hard of hearing will be invaluable in the ongoing planning, implementation and evaluation of "A Sound Start." British Columbia has a number of considerations that must be addressed to have a successful province-wide implementation. These include:

- regionalized health services;
- remote regions;
- cultural diversity;
- islands; and
- rural and urban settings.

Regional implementation will need to be designed at the local level with ongoing consultation and discussion between local providers, clients, EHDI-BC committees and the coordinating agency (PHSA). "A Sound Start" will need to be flexible enough to accommodate local issues.

Full implementation is expected to take 2 years. Areas with existing programs (VIHA, Fraser East) and large birthing hospitals are proposed to be amongst the first to implement. This will provide some experience with different sizes of birthing hospitals and both rural and urban settings. Recognizing that program implementation will have continuous small cycles of quality improvement, it will not be feasible to implement in all Health Authorities in the first year.

Year 1:

- Recruitment of Provincial and Regional Coordinators
- Consultation process and identification of key partners in each Health Authority and Service Delivery Region
- Identification and development of service links
- Designation and start-up of Regional Audiology Centres
- Development of evaluation strategy and framework
- Development of implementation Support Documents, including: Audiology Assessment Protocol and Guidelines, Prescription of Amplification Protocol and Guidelines; Screening Protocol and Guidelines
- Recruitment of trainers
- Training programs will be developed for screening personnel, audiologists and interventionists
- Development of training programs for intervention and communication development
- Development of resources
- Identification and/or recruitment of screening personnel

- Training for screening personnel in screening program pilot sites
- Purchase of equipment
- Initiation of screening program pilots in at least 3 Health Authorities.

Year 2:

- Implementation in remaining Health Authorities.
- Program evaluation and continuous quality improvement.

Working committees in the following areas will continue to operate as a resource and advisory to the Steering Committee and provincial program, with the terms of reference listed below:

Diagnostic Audiological and Medical:

- Develop and recommend protocols for diagnostic audiological and medical assessment and monitoring of infants and young children with PCHL;
- Identify current and best practices;
- Develop process for moving current to best practice;
- Develop guidelines for training and maintaining competencies;
- Develop benchmarks and process indicators;
- Consultation to service providers; and
- Evaluate new and emerging technology.

Hearing Devices:

- Develop model for timely and accessible provision of amplification and required follow-up;
- Develop and recommend amplification protocols and appropriate amplification choices for infants;
- Develop a protocol for referral to Cochlear Implant Program(s);
- Identify existing and additional equipment and resources needs;
- Identify current and best practices;
- Develop the process for moving current to best practice;
- Develop guidelines for training and maintaining competencies;
- Develop benchmarks and process indicators;
- Consultation to service providers; and
- Evaluate new and emerging technology.

Family-Consumer/Intervention:

- Ensure that the perspectives of families of children with hearing loss, individuals who are deaf and hard of hearing, and interventionists who serve them are incorporated into the decision-making process of the development of a provincial strategy for early hearing detection and intervention through consultation with Steering Committee and Working Committees;
- Develop a model for intervention services identified with PCHL;
- Compile a reading base of current research and anecdotal evidence of child and family needs;
- Compile a list of family-centred care practices that will be reflected in the program model;
- Identify child and family outcomes and indicators;
- Develop a list of recommended tools/strategies for measuring outcomes related to communication and socio-emotional development; and
- Identify qualifications, competencies and training needs for interventionists.

Evaluation and Outcomes:

- Develop a framework for program monitoring, evaluation, and reporting that incorporates outcomes (benchmarks) and indicators for all screening, diagnostics assessment, amplification and intervention components;
- Survey existing data systems and capacity of these systems to provide data requirements or link with a separate database;
- Compare existing data management systems (cost, ease of use and capacity); and
- Make recommendations for data collection and management.

Other provincial committees, regional committees or advisory groups will be struck on the basis of specific need.

INFRASTRUCTURE AND ADMINISTRATION

Program implementation and ongoing management of the program will require additional human resources. There will be a Provincial Coordinator position and Regional Coordinators located in each Health Authority.

Program implementation activities include:

- developing equipment specifications (number by province, region, hospital);
- developing equipment and supplies purchase agreements;
- completing capital expenditures;
- developing and piloting training and informational resources;
- developing program protocols and guidelines;
- liaising with and supporting Regional coordinators and Health Authority administration; and
- developing Provincial and Regional Coordinator position descriptions.

Ongoing program management activities include:

- monitoring program outcomes, indicators, compliance, and quality assurance through continuous quality improvement;
- providing training;
- reviewing and revising training materials, information resources ;
- reviewing budget and auditing;
- providing professional consultation; and
- conducting ongoing review of emerging evidence for program changes.

Provincial Coordinator:

The provincial Coordinator position will:

- support the implementation of the program;
- provide professional expertise and assistance with program management, policy development, program planning and implementation;
- monitor and evaluate program and financial data;
- ensure the continuing validity of program protocols based on the current professional research;
- manage and distribute the provincial budget to include central coordination of equipment and training costs;
- provide expert advice and support to local programs related to implementation and delivery of the program; and
- provide professional leadership and support for the effective integration and delivery of early hearing detection and intervention.

Both the Regional and Provincial Coordinators positions are critical to the successful implementation and sustainability of the program. Without these positions, monitoring the program effectiveness and accuracy will not be possible. Quick response for “troubleshooting” is critical. A clear chain of responsibility will ensure that Health Authorities are not left unsupported and that the provincial program is accountable to both the Health Authorities and the funding Ministries.

Regional:

The program will be implemented according to the five Regional Health Authority boundaries and existing administrative structures. There will be a Regional Coordinator and Regional Audiology Centres.

Requirements for local implementation include the capacity of a Regional Coordinator to lead and facilitate implementation of all program components in the region and service delivery areas.

In choosing locations for Regional Audiology Centres, the following were considered:

- the presence of at least one audiologist with experience in assessment of infants or young children;
- capacity for linkages between the audiologist(s) and local special care nurseries
- population size;
- geographic distribution; and
- capacity of the Health Authority to staff and support a center.

Prior to initiating any screening, each region must have expertise in screening, audiology assessment (diagnostic audiology), hearing aid evaluation/fitting (habilitative audiology), and access to personnel trained in all methods of communication with and by persons who are deaf and hard of hearing. Although it may take several years in very small service delivery areas to identify the first child with PCHL, the capacity to provide diagnostic assessment, amplification, intervention must be available from the outset. Services will be delivered through a locally developed integrated system of service providers as much as possible.

Each Regional Health Authority will partner with local stakeholders including families, consumer organizations, physicians, hospital staff, midwives, the education sector, interventionists and other relevant service providers.

The role of the Regional Health Authority in implementation will be to:

- incorporate planning and management of the program into its existing infrastructure;
- develop and implement the program according to Provincial guidelines and protocols;
- establish and maintain ongoing linkages with all the hospitals and paediatric audiologists within their service delivery area;
- develop and administer the regional budget;
- receive the funding from the Ministry and distribute or expend it according to the local plan;
- enter into agreements with other local agencies or individuals that may provide service, including intervention services; and
- collect and maintain the program data.

BUDGET

A detailed budget is found in Appendix I: *Budget Summary*. There is a 5 year budget plan, with Year One including start-up costs. The costs of intervention vary significantly for the first 5 years due to cumulative cases, amount of services needed, and previous age of detection of PCHL depending to a large extent on the degree of hearing loss. Previously, children with severe to profound hearing losses were detected earlier (by age 1-2 years) with mild and unilateral losses rarely detected before school entry.

The budget costs were based on current practice, a literature review, best “estimates” of existing service providers, the Ontario Infant Hearing Screening Program and the experience of VIHA-South in implementing a universal newborn hearing screening program. Staff costs, in most areas of the budget, are additional hours required. There may be some potential efficiencies as the program is implemented. However, many public health audiology services already have significant and unacceptable waits which would impact the ability to implement “A Sound Start”. There was an attempt to balance these factors. The budget represents most additional costs to existing services, however there are some contributions that will be needed from the Health Authorities (for example, staff time for training and increased infrastructure expenses, such as Human Resource and Payroll costs).

A short summary of the costs of a provincial program for early hearing detection and intervention are summarized in the table below for Year 1 (start-up) to Year 5 (ongoing):

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Average Annual Cost
	\$	\$	\$	\$	\$	
1. a)Screening - Total Number of Babies	23,208	38,135	38,135	38,135	38,135	
- Total Operating Cost	\$ 928,320	\$ 1,525,384	\$ 1,525,384	\$ 1,525,384	\$ 1,525,384	\$ 40 per screen
b) Screening Equipment Costs & Maintenance	\$ 2,275,000	\$ 455,000	\$ 455,000	\$ 455,000	\$ 455,000	
c) Regional Centre Equipment Costs & Maintenance	\$ 703,118	\$ 140,624	\$ 140,624	\$ 140,624	\$ 140,624	
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification						
a) Hearing Risk Monitoring:						
- No. of at risk children	1,381	3,650	5,919	6,807	6,807	
- Total Cost	\$ 79,439	\$ 190,260	\$ 288,404	\$ 326,820	\$ 326,820	\$ 48 per high risk child
b) Diagnostic and hearing aid assessments						
- Number of Children	696	1,217	1,337	1,384	1,384	
- Total Cost	\$ 136,560	\$ 284,082	\$ 373,988	\$ 420,622	\$ 420,622	\$ 196 per child yr 1 \$ 304 per child yr 5 due to cumulative effects of more intensive follow up of hearing impaired children identified prior two years
c) Amplification (Hearing Aid Cost)	\$ 301,855	\$ 496,200	\$ 496,200	\$ 496,200	\$ 496,200	\$4,135 per Hearing Aid
3. Intervention - Total Cases	73	193	313	433	480	
- Total Labour Cost	\$ 339,990	\$ 880,943	\$ 1,247,708	\$ 1,442,225	\$ 1,528,810	\$3,185 per child
- Total Materials and Equip.	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000	
4. Public/Professional Education	\$ 23,208	\$ 63,135	\$ 38,135	\$ 38,135	\$ 38,135	
5. Training	\$ 227,493	\$ 132,496	\$ 132,496	\$ 132,496	\$ 132,496	
6. Outcomes and Evaluation	\$ -	\$ 680,000	\$ 70,000	\$ 70,000	\$ 70,000	
7. Health Authority Infrastructure Support	\$ 822,487	\$ 793,554	\$ 732,754	\$ 732,754	\$ 732,754	
8. Total Program	\$ 5,877,470	\$ 5,681,679	\$ 5,540,693	\$ 5,820,260	\$ 5,906,845	

CLOSING

“A Sound Start”

“A Sound Start” is a B.C. initiative that will improve the future of deaf and hard of hearing babies and their families. Deaf and hard of hearing children will have access to good communication, improved literacy and learning. Each year, approximately 120 babies are born unable to hear. Imagine not being able to hear your mother’s or brother’s voice, and every day trying to make sense of the world around you while missing a major sensory input – sound.

A baby with hearing loss cannot be detected by looking at him. She does not come with a “warning” label to help parents and caregivers know that special help and skills are needed for development of good communication skills, social skills and learning. The most caring of parents and the best trained observers will not know.

In B.C., each year many babies with hearing loss are not identified until they are ready to enter school. The evidence is clear that newborn hearing screening leads to early detection of hearing loss. Early detection and appropriately resourced and designed habilitation services lead to early intervention. Early intervention will improve outcomes for infants with hearing loss and their families.

Learning begins from the moment babies are born. The “brain” and “sensory” mechanisms are primed and ready to learn. This capacity diminishes as children grow. Missing these critical first few months and years of learning puts children at a huge disadvantage. Late-identified deaf and hard of hearing children require more resources to close the gaps; however, they often never catch up because they have missed critical periods for learning. Average reading levels for late-identified deaf and hard of hearing students range from Grade 3 to 6. How can individuals experience success and independence when they are barely able to read? To achieve maximum cost effectiveness, resources need to be directed to where they will make the biggest positive difference. For hard of hearing and deaf children, this is early – starting in the first few months of life.

Hearing loss is a relatively low incidence disability. Fragmented and small, local efforts will not significantly improve outcomes for the population of deaf and hard of hearing children. A provincial initiative that is evidence based and incorporates best practice will allow for equitable, accessible and early detection and intervention and lead to the best outcomes. B.C. is currently behind in providing an acceptable level of care to infants with hearing loss and their families. Detection and intervention services for young infants are desperately in need of updating to ensure that an acceptable standard of care is provided in our province.

The development and implementation of 'A Sound Start' will require ongoing consultation with the Health Authorities, families, consumer groups, and other service providers. There will be new partnerships and strengthening of existing partnerships.

- Babies with hearing loss **can** be identified soon after births **if** newborn hearing screening is in place.
- Babies with hearing loss **can** develop language at a rate and level consistent with their hearing peers **if** early, quality and appropriate intervention services are in place.
- Parents **can** be provided with opportunities to learn how to best nurture, parent and teach their hard of hearing or deaf baby **if** hearing loss is detected and intervention begins in the first six months on life.

We cannot change the history of deaf and hard of hearing children, youth and adults. We can change the future.

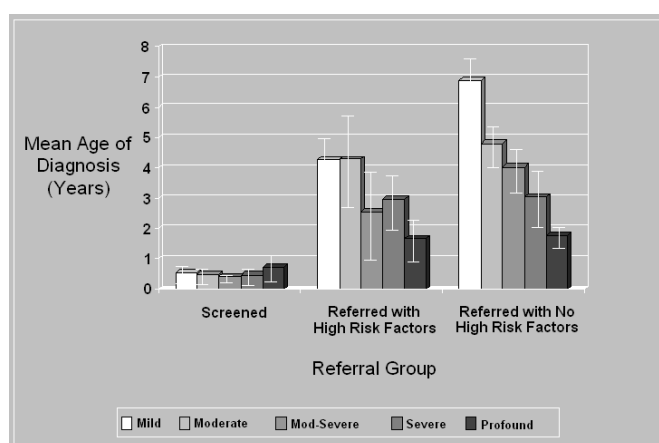


Appendix A

Age of Detection and Prevalence of Permanent Congenital Hearing Loss (PCHL)

The age of detection of PCHL varies greatly in the absence of universal newborn hearing screening (UNHS) (Van Naarden et al., 1999; Strong et al., 1994; Mace et al., 1991). There is an inverse relationship between degree of hearing loss and the age of diagnosis, with children with mild hearing loss being detected far later than children with profound hearing loss.

A large-sample study from Ontario (Durieux-Smith and Wittingham, 2000) revealed that mean age of diagnosis in unscreened children referred by physicians because of concern about hearing was 2.8 years in the period 1991-95. For children with moderate impairment and no risk factors, the mean age was about 5 years. This is contrasted with 5.7 months for a screened group of children at risk.



In the presence of UNHS, the age of diagnosis of PCHL ranges from 2 to 3 months (Mehl & Thompson, 2002; Dalzell et al., 2000; Vohr et al, 1998). For children identified through UNHS, there is no significant difference in the ages at diagnosis for children with different degrees of hearing loss.

Since the advent of UNHS in the province of Ontario in 2002, average age of detection, regardless of degree of loss, has indeed dropped to less than 4 months in the second year of program implementation.

Vancouver Island Health Authority, South implemented a universal newborn hearing screening program in January 2002. In the first three months of the program, three infants (all well-babies from Mother-Babe) were identified with PCHL (one moderate; one moderate to severe; and one severe to profound). Diagnosis was completed on all infants in an average of 32 days (range 23-49 days). All children were referred to intervention within a few days of confirmation of hearing loss and receiving service shortly thereafter. Hearing aids were fit on all children by age 6 months, with an average age of 99 days and a range of 72-127 days.

Permanent congenital hearing loss (PCHL) is a serious public health problem affecting at least 1 to 2 babies in 1000 births, with some studies suggesting as many as 6 babies 1000, depending on the degree of hearing loss included. The most comprehensive data available is from the United Kingdom (Fortnum

et al., 2001). The prevalence of a moderate degree of hearing loss was found to be approximately 1 per 1000 births. The prevalence triples to approximately 3 per 1000 births (Prieve et al., 2000, Finitzo et al., 1998) when milder and unilateral hearing losses are included.

Some groups of children are at higher risk of PCHL due to the presence of a risk indicator. Risk indicators can be divided into two categories: those present during the neonatal period and those that may develop as a result of certain medical conditions or essential medical interventions in the treatment of an ill child. The estimated risk of PCHL when no risk factors are present (0.54 per 1000 births) increases dramatically in children attending the SCN (3.2 per 1000 births) or if there is a family history of hearing loss (7.6 per 1000 births) (Fortnum & Davis, 1997). Data have been considered from an epidemiologic study of PCHL in the Trent Region of Great Britain from 1985 through 1993 (Fortnum & Davis, 1997) and the recent NIH multi-centre study (Norton et al, 2000). The prevalence of hearing loss for each risk factor was determined by dividing the number of infants with the risk factor and hearing loss by the total number of infants in the sample with a given risk factor. The most common risk factor is an illness or disorder that results in a Special Care Nursery stay of 48 hours or greater. Hearing loss was associated with 11.7% of infants with syndromes associated with hearing loss, 6.6% of infants with a family history of hearing loss and 4.7% of infants with craniofacial anomalies (Cone-Wesson et al., 2000). Infants with these risk factors may be found in either the well baby nursery or Special Care Nursery.

Appendix B

EHDI-BC Steering and Working Committees Early Hearing Detection and Intervention – British Columbia (EHDI-BC)

A group professionals working in BC in fields directly related to pediatric hearing loss. Members work in the field of Otolaryngology, Audiology, Education and Intervention.

Mandate

“To develop and deliver a business plan for a provincial strategy for the implementation of early identification and intervention services for children with hearing loss based on available evidence and best practices.”

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EHDI BC Steering Committee Terms of Reference

Steering Committee Key Roles and Responsibilities of Members:

1. To consult, coordinate and collaborate the EHDI-BC efforts.
2. To provide guidance and be a resource for the Working Committees.
3. To promote and advocate for the implementation of a provincial early detection and intervention service with professional colleagues, provincial government ministries and Health Authorities.
4. To support and contribute information sharing provincially and nationally.
5. To attend regularly scheduled meetings.
6. To liaise with one or more Working Committees to facilitate project cohesiveness with other Working Committees and the Steering Committee.
7. To ensure the vision is implemented.

Steering Committee Key Activities:

1. To develop informational materials for government, health authorities and community.
2. Identify and liaise with key governmental and community contacts to advocate for EHDI-BC.
3. Assist with the development and collaboration of Working Committees.

EHDI-BC Will Reflect These Principles:

- Use of research, evidence and best practice information
- A continuum of service including communication, identification, intervention and evaluation
- Integrated and coordinated services
- Family- and child-centred care
- Sustainability and cost effectiveness
- Accountability
- Recognition and support of the geographical and cultural diversity in B.C.

Appendix C

Screening Methods

Automated Otoacoustic Emissions (AOAE) and Automated Auditory Brainstem Response (AABR) are the two principal tools used for newborn hearing screening. Both methods are objective physiological tools that allow for a simple pass or fail criteria to be applied.

Otoacoustic emissions (OAEs) are an auditory phenomenon detectable in the human ear canal at very soft levels, close to the threshold of hearing and generated by the hearing process in the cochlea. The OAEs are transmitted back through the middle ear and are detected by a miniature microphone placed into the ear canal. OAEs are absent with hearing loss of greater than 35 dB and can, therefore, be used as a screening tool for mild or greater hearing losses.

Auditory Brainstem Responses (ABR) are minute, neuronal action potentials that are generated in response to sound. They originate in the auditory pathways in the brainstem. They are recorded using EEG electrodes on the head, after computer extraction from the spontaneous neural activity of the brain. Advances in technology have led to the development of automated detection of the presence or absence of ABR waveforms. This can be used as a screening tool for mild or greater hearing losses and other auditory disorders.

An example of an AOAE screener



An example of an AABR screener



Appendix D

Decision Making and Supporting Evidence for Screening

Considerations for the Screening Component are:

- To maximize coverage of the newborn population (at least 95% of live births);
- To minimize the false-positive rate of screening (keep refer rates less than 3-4%)
- To use existing resource constraints most effectively.

Babies who are sick during their newborn period comprise about half of all cases of hearing loss in infancy. Therefore, 50% of babies with hearing loss can be detected by screening the 10-15% of the babies that will have a Special Care Nursery stay. In order for the benefits of the much greater workload in screening the 85% - 90% of babies who graduate from well-baby nurseries to be realized, high coverage is most important. The American Academy of Paediatrics (AAP) and The Joint Committee on Infant Hearing (JCIH) in their Year 2000 Position Statement have advocated screening a minimum of 95% of live births. Several large-scale programs in the U.S., several sites of the regional Infant Hearing Program regions in Ontario and VIHA-South are achieving screening coverage in the 90-99% range.

The AAP recommends a false positive rate of no greater than 3%, similar to the recommended refer rate of less than or equal to 4% by JCIH (see Note* below). Programs are achieving these rates by using multi-stage screening protocols, usually involving more than one screen before hospital discharge and a follow-up re-screen in the community.

Options for predischarge screening include single-stage screening by AOAE or AABR, and two-stage screening with any of the combinations AOAE/AOAE, AOAE/AABR, AABR/AOAE and AABR/AABR. The key factors in determining the appropriate option are the sensitivity, specificity, refer rate, could not test (CNT) rate of the combination of screening procedures, logistical feasibility (access to assessment or rescreening, capacity for accommodating referrals to diagnostic centres) and cost. While an outpatient re-screen is common, some programs with two-stage in-patient screening move straight to diagnostic assessment after hospital discharge. This is a balance between the costs of rescreening versus diagnostic assessment.

AABR screening is generally considered to be more accurate than AOAE screening because the sensitivity of AABR to hearing loss is very high (estimated at 95%), and the auditory system is tested up to and including the brainstem. However, it takes longer and requires a higher level of expertise/training, as well as more expensive equipment and supplies.

AOAE screening still has a high sensitivity for detecting hearing loss (estimated at 90%), however AOAE only tests the system only up to the cochlea, and it will miss more central disorders such as auditory dys-synchrony. This is an auditory disorder that may constitute 5-10% of all infants with sensorineural hearing impairment. While the majority of infants with this disorder may be SCN graduates, some may attend the Well-Baby Nursery (WBN). Screening programs that are designed to identify infants with auditory dys-synchrony will need to incorporate AABR screening for at a minimum, SCN infants.

AABR is likely to have higher specificity, provided it is possible to test newborns when they are sleeping quietly. Both AABR and AOAE require a quiet baby and a quiet test environment. AOAE is more

sensitive to errors in placement of the insert probe tip, and to minor middle ear disorders such as debris, or residual fluid.

The advantage of repeating a screen of any kind lies in the causes of screening error. Common causes include poor behavioural state of the newborn, earphone placement errors and transient external ear or middle ear conditions. Screening the infant more than once will improve errors due to the first two variables. The balance of the evidence to date suggests that multi-stage protocols for pre-discharge screening are feasible with high coverage in the WBN, and give much lower false-positive error rates. Refer rates at discharge below 2% can be expected, decreasing to below 1% for diagnostic assessment.

There is no one screening method recommended for well babies. Both AOAE and AABR, or more often a combination of AOAE and AABR screening, can be used effectively.

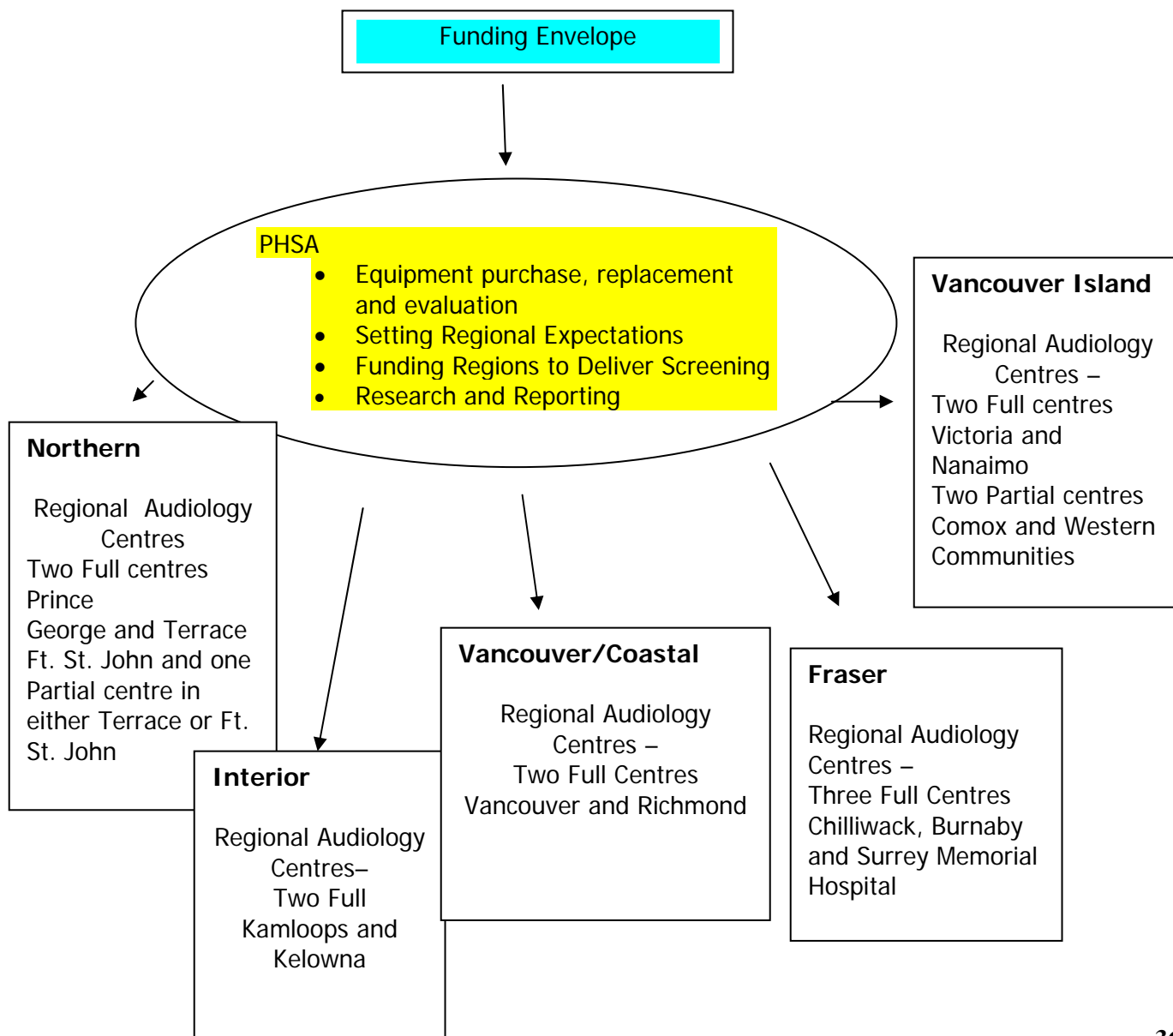
* - Refer rate is the percentage of infants referred from the Screening Component to Diagnostics. Pass rate is the percentage of infants passing screening of the total screened. Because most babies are free of hearing loss, the pass rates approximate specificity and the refer rates are very close to the false positive rates.

Appendix E

Regional Audiology Centres

Regional Audiology Centres:

The location of the Regional Audiology centers needs to be identified by each Health Authority. What follows is a simple diagram of the funding flow and a recommended number and location of centers in each Region.



Appendix F

Hearing Aids - Needs for Infants

1. Physical characteristics:
 - a. Behind-the-ear casing
 - b. Paediatric sized ear hook
 - c. Filter in ear hook that provides a minimum of 6 dB attenuation at 1000 Hz.
 - d. Tamper-proof battery doors
 - e. A system for locking the volume control (or disabling it in programming)
 - f. Water resistant, if possible
 - g. Direct audio input, if the child will use FM at home or in preschool

2. Electroacoustic characteristics
 - a. Most infants will be candidates for wide dynamic range compression. Possible exceptions to this are children with severe to profound hearing loss. In general, devices should provide some form of non-linear signal processing, with lower compression thresholds available for lower-gain devices.

 - b. Digital signal processing is not necessary, but is preferred because parents will perceive this as an important option. Note: in order to have a broad range of gain strengths, some high power analog devices may need to be included.

 - c. Flexibility of fittings within each instrument is very important. Flexibility is enhanced by the presence of programmability, specifically due to the following features:
 - i. Multiple bands of frequency adjustment
 - ii. Multiple channels of compression (3 to 5 is likely sufficient, more than this is NOT problematic)
 - iii. Adjustments of gain at more than one input level
 - iv. Adjustments for compression threshold
 - v. Adjustments for output compression limiting
 - vi. Multiple memories, in some cases (not routinely needed but may be useful in cases of conductive overly, fluctuating hearing loss, etc)

 - d. Feedback is a major problem in infant hearing aid fitting. The following features will reduce the probability of feedback:
 - i. Low group delay (measured in milliseconds)
 - ii. Feedback reduction schemes may be offered, but their function should have been verified in clinical evaluations

Appendix G

Inventory of Local and Provincial Outreach Intervention Services

Children with a hearing loss, age birth to five, currently receive services from a variety of sources.

Provincial Resources:

Hearing Loss Resource Team, Sunnyhill Health Centre

Children with confirmed hearing loss aged birth to 16 years and residing in B.C. are eligible. In most cases, a nurse clinician specialist who involves other team members as needed initially completes a case review. Other team members include: psychology, developmental pediatrics, otolaryngology and audiology. After assessments are completed and recommendations made, the child and family are then referred to other agencies or organizations that provide habilitation services, either provincially or locally.

Specialized Early Intervention Programs:

BC Family Hearing Resource Centre

Deaf Children's Society of B.C

Vancouver Oral Centre

Families in the Lower Mainland who have children aged birth to 5 can receive services directly from the above three agencies. These services may include (depending on the need of the child/family and the specific service) an individualized intervention program, individual and group sign language instruction, enrolment in preschool programs or communication groups and/or parent education/support. Team members include: speech-language pathologist, teachers of the deaf and hard of hearing, and early childhood educators, and sometimes other professionals.

Queen Alexandra Center for Children's Health

Eligible children residing in Southern Vancouver Island can receive services. These services include home-based programs (for children aged birth to 3 years), center-based family participation programs (for children aged 3-5 years), and itinerant consultant services to community programs (for children aged birth - 5 years). Communication methods may include auditory-verbal and sign-assist.

Outreach Services:

BC Family Hearing Resource Centre

Deaf Children's Society of B.C

Vancouver Oral

Families residing outside the Lower Mainland can receive outreach services from the above three agencies.

BC Family Hearing Resource Centre:

Speech/language Pathologists and teachers of the deaf and hard of hearing travel to communities throughout BC to provide consultation to families and to the family's local community service providers. Families can travel to BCFHRC for short intensive sessions. Community Service Providers receive training and workshops in their own community or can travel to BCFHRC facility. Sign language instructors travel to provide intensive, short-term, workshops to early childhood educators and families. Ongoing family support is available by phone. A provincial Parent to Parent support network is available, facilitating contact, mutual support and sharing between families.

Vancouver Oral Centre:

Families can travel to the Vancouver Oral Centre to participate in their preschool programs or individual sessions with a teacher of the deaf and hard of hearing or auditory habilitationist. VOC also provides Cochlear implant consultation to teachers of the deaf and hard of hearing working in preschools or schools.

Deaf Children's Society of B.C.

Families can participate in sign language instruction via weekly video conferencing or in the family's home if a local instructor is available. A Family Support Worker is available to meet the family and can provide counselling, workshops or playgroups in the community as requested by the families. For families who wish to travel to the Lower Mainland, individual sign language instruction, family support, and the preschool program are available. A one-week Family Learning Vacation is offered during the summer in which families receive sign language instruction and participate in workshops. A program is available for children under five years of age, while older siblings may attend the Deaf Youth Today program.

Other Services:

Many children, especially those living outside the Lower Mainland, may receive some of their services from a speech/language pathologist in the Health Unit or Child Development Centre. Often many of these community service providers are receiving consultation from a program specializing in children with a hearing loss.

Many other children receive services from an Infant Development Consultant. This is particularly true of children who have been diagnosed with additional needs. In some areas the school district teacher of deaf and hard of hearing may provide some services to pre-school children.

Appendix H

Hearing Loss Registry

GOAL

To create a registry of children in BC with developmentally significant¹ hearing loss, that can be used to:

- Support a program of universal early hearing detection and intervention
- Link the registry with population-based, longitudinal education and health data (EDUDATA and the BC Linked Health Database)
- Track the developmental trajectories of children with hearing loss and their use of intervention services, from birth to adulthood.

The Hearing Loss Registry would comprise a common, computer-based registration system for children with hearing loss in B.C., which will consist of both historical records of previously diagnosed children that will be used for research purposes, and a current time file of newly diagnosed children.

Over the past year, the historical and current data sources for childhood hearing loss in BC have been investigated. The existing records are inconsistent and fragmented. For example, the educational records exist in paper form only, and are held by the early intervention centres, Hearing Resource Teachers, or by the school boards. Existing and historical audiology records are often, but not always, computerized, and different systems and guidelines are used to collect data.

Developing a Hearing Loss Registry for children in B.C. would require:

- creating a computerized data abstraction form;
- obtaining ethical approval from the Ministries of Health and Ministry of Education; negotiating access to records around the province;
- training and sending data record abstractors to all data sources across the province to abstract all child records;
- collating all of the records and resolving internal contradictions in order to create the registry.
- working with EDUDATA, the BC Linked Health Database, and the Freedom of Information and Protection of Privacy (FOIPP) Commissioner to permit linkage of the registry to the health and education databases.

Appendix I

COSTING METHODOLOGY and BUDGET

Detailed costings for each health authority are included at the end of this section. The following assumptions and methodology were used to estimate costs.

First, all wages are estimated at 2003/04 health sector rates, with 20% added for benefits. Second, for each hour of direct service, a factor of 16% is added for earned vacation, sick time, and stat holidays. As well, 22% is added for non-clinical time (also known as 'non-service recipient activities,' such as meetings, functional department requirements, reporting, research, education). Paid coffee breaks, which are equivalent to 7% of hours paid, are included in the 22%.

A screening rate of 95% of babies born in the province is targeted. Based on current incidence, it is expected that 3%, or 120 infants, will be identified as children with hearing loss annually. The numbers are as follows:

Confirmed Hearing Loss Cases per Year by Health Authority			
Health Authority	<i>Live births</i>	# Stage 1 Screens	# Confirmed HL Per Year
	<i>in 2001</i>	<i>based on 95 % rate</i>	<i>.3% Live Births</i>
Vancouver Coastal	5,068	4,815	15
Interior	5,546	5,269	17
Northern	3,362	3,194	10
Vancouver Island	5,616	5,335	17
Fraser	13,267	12,604	39
PHSA	7,282	6,918	22
Total Province	40,141	38,135	120

Detailed costings by health authority are appended, and are based, for the most part, on the respective number of births and number of children identified with hearing loss.

VIHA, the Fraser Health Authority, and the Interior will implement the program in the first year, followed by Vancouver Coastal, the North, and the PHSA in the second. Costs are adjusted accordingly. One time equipment costs are significant during the first two years of the program. Equipment costs fall in following years, but costs escalate for intervention and follow up of at-risk or hearing loss children, until stabilizing by year 5. Phasing the program in over the first 2 years, therefore, has a levelling effect, so that one time equipment costs do not skew first year costs upward.

The principles used to derive costs are as follows:

1. Screening

1.a) Screening Costs: Vancouver Island Health Authority has a program for screening children in the south island. Its costs per case were used, with some adjustment based upon the expectation that the technicians may be classified at a slightly higher pay rate. As well, the cost was increased to fully capture the impact of earned vacation, stat holidays, and sick time. The resulting cost was calculated, thus, at \$40 per baby, excluding screening equipment.

1.b) Screening Equipment: The following principles were used to determine equipment needs by region: i) Where hospital births number fewer than 500 per year, a two-stage Automated Otoacoustic Emissions (AOAE) screen will be offered, with no Automated Auditory Brainstem Response (AABR). ii) In hospitals with greater than 500 births per year, a second-stage AABR will be offered to all AOAE refers. In both cases, babies would receive a diagnostic ABR in the regional audiology diagnostic center if indicated after second stage screening. iii) Each Special Care Nursery will require one AABR, with an additional AABR for SCNs with 1,000 births or more. iv) 35 health units throughout the province will be equipped with one AOAE screener for missed babies and home births. These will be shared with hospitals with fewer than 50 births per year. v) Annual maintenance, warranty, and replacement costs are estimated at 20% of equipment purchase costs.

Equipment costs are summarized in the following table:

Screening Equipment Costs

Health Unit	Number of Units		Subtotal \$	Plus No. Health Unit OAE	Health Unit \$	Cost per HA
	OAE	AABR				
North	12	7	\$ 355,000	8	\$ 120,000	\$ 475,000
Island	6	5	\$ 215,000	9	\$ 135,000	\$ 350,000
Interior	16	4	\$ 340,000	8	\$ 120,000	\$ 460,000
Coastal	9	3	\$ 210,000	6	\$ 90,000	\$ 300,000
Fraser	14	10	\$ 460,000	4	\$ 60,000	\$ 520,000
PHSA	8	2	\$ 170,000	0	\$ -	\$ 170,000
TOTAL Units	65	31	\$ 1,750,000	35	\$ 525,000	\$ 2,275,000
Cost per Unit	\$ 15,000	\$ 25,000				

1.c) Regional Audiology Centre Equipment (Diagnostics and Habilitation):

Equipment needs for regional audiology diagnostic and habilitation centres within regions are based on the number of children requiring diagnostics and habilitation. Such resources will be centralized in regional units to maintain expertise and keep costs down; however, geographic requirements must be considered as well. For each full centre, we have proposed the purchase of 1 diagnostic ABR machine (estimated cost \$40,000, as opposed to the automated ABR used for screening, which is \$25,000) and 1 AudioScan, hearing aid analyzer (estimated cost \$15,937). For each partial centre we have proposed only the AudioScan. The number and location of centres and which equipment is needed in each will continue to be negotiated with the health authorities. As an example in the North, we have suggested 2

Full centres, one in Prince George and one in either Terrace or Ft. St. John; 1 partial centre in either Terrace or Ft. St. John (total cost for that health authority regional audiology centre equipment would be \$127,811 plus 20% annually for replacement, repair, and calibration. Total costs for each health authority are shown in the costings appended.

2. Audiology

2.a) Hearing Risk Monitoring: Based on BC HPHR data, 7% of children screened will be high risk, but only 85% of them will show up for high risk monitoring. 85% of 7% is 5.95% of total births screened. Of these, 33% will require a second appointment. Applying this to the population, the number of high risk screening appointments is calculated as follows:

Audiology Hearing Risk Monitoring, Calculation of Number of Annual Appointments

Health Authority	Annual Number Births Screened	Number of High Risk Children @ 5.95% Total Births Screened	Number of High Risk Appointments			
			Yr 1	Yr 2	Yr 3	Yr 4
Implemented Year 1						
Vancouver Island	5,335	317	422	740	1,057	1,057
Frasers	12,604	750	997	1,747	2,497	2,497
Interior	5,269	314	417	730	1,044	1,044
Implemented Year 2						
North	3,194	190		253	443	633
Vancouver Coastal	4,815	286		381	667	954
PHSA	6,918	412		547	959	1,371
All	38,135	2,269	1,837	4,399	6,668	7,556

Each appointment averages 45 minutes, but is costed at 1.06 hours earned including benefit hours and non-clinical time.

2.b) Diagnostic Assessment and Hearing Aid Evaluation:

Babies who refer on both stages of the screening procedure appropriate to their level of risk will be referred to audiologists with expertise in evaluating infants to determine the presence, type and degree of hearing loss. The costs of these services, including hearing aid prescription, verification, and fitting, were calculated using the following assumptions:

Appointments average 2.5 hours. Grossing this up for earned vacation, etc, plus non-clinical activities results in 3.5 hours costed per appointment.

The number of appointments was determined as follows:

Year One:

- i) Based on experience in other jurisdictions, 3% of babies screened (or 1,144 babies) will require diagnostic services.
- ii) Of the 1,144 babies screened, 819 of these will be found to have normal hearing and be discharged from the program, leaving 325 requiring further diagnostic assessment.

- iii) 273 of the 325 will need one more appointment. 204 will be found to have normal hearing and will be discharged from the program. 69 will have either a mild or unilateral hearing loss. For this group diagnostics are then complete for the first year.
- iv) The 52 babies remaining will have greater than mild hearing losses and will need three more appointments/hearing aid assessments to complete the assessments.

Year Two and Subsequent Years:

- i) Annually, Year 1 numbers repeat as new children are identified in the screened population.
- ii) Ongoing hours are required for children identified the previous two years. These are calculated as follows:
 - a. For the 120 children with hearing loss, 68 will be mild or unilateral. They will need 4 diagnostic/hearing aid appointments annually.
 - b. 52 will have greater hearing loss, requiring 8 annual diagnostic/hearing aid appointments.

For clarity, the above is summarized in the following table. The raw numbers are converted to percentages, and these percentages are then applied to each health authority in order to determine costs per health authority (calculated at the HSA rate for an audiologist I step 6.) For the health authority costing, costs are adjusted to account for the phasing in of the program over two years.

Diagnostic Audiology - calculation of hours of service									
Diagnostic Audiology Assumptions	Year 1			Year 2 Incremental			Total Yr 2 Hrs	Yr 3 Incremental Hrs	Total Yr 3 Hrs
	Number of Children	Number of Appointments per Child Per Yr	Total Hrs of Appointments @ 3.5 hrs earned	Number of Children	Number of Appointments per Child Per Yr	Total Hrs of Appointments @ 3.5 hrs earned			
Number of Children Referred from Screening at 3%	1,144	1	4,004						
Number who require only one additional appointment	273	1	956						
Number who require 3 additional appointments	52	3	546						
Children with Mild Hearing Loss that Require Habilitative Audiology				68	4	952			
Children with Greater Than Mild Requiring Habilitative Audiology				52	8	1,456			
Total for the Province			5,506	120		2,408	7,914	2,408	10,322
Total Hours as a Percentage of Children Screened in order to calculate regional breakdown			14.44%			6.31%	20.75%		27.07%
Total Hours as FTE's			2.93			1.28	4.21		5.49
Total Cost			\$224,360				\$ 322,491		\$ 420,622

In order to apportion the total diagnostic hours to the regional health authorities, total hours as a percentage of babies screened was applied to the numbers for each region. The total hours are shown as follows. (note: they are not adjusted to account for the phasing of program implementation, but they are adjusted in the detailed costing for each health authority below.

Health Authority	Babies Screened	Yr 1	Y 2 Hours	Yr 3
		Total Hr	Total Hrs	Total Hrs
Vancouver Coastal	4,815	695	999	1,303
Fraser	12,604	1,820	2,616	3,411
VIHA	5,335	770	1,107	1,444
Interior	5,269	761	1,093	1,426
North	3,194	461	663	864
PHSA	6,918	999	1,436	1,872
	38,135	5,506	7,914	10,322

2.c) Amplification:

HEARING AID BUDGET

Item	Cost	Cost over 3 years
Binaural fit plus 1/3 cost for loaner.	Average manufacturer cost \$800	1833
	Dispensing fee \$500 each, 2 aids	1000
	Accessory Kits: Included in dispensing fee	0
Earmolds: 19 sets in first 3 years, within 3 month remake period no charge, 11 pairs charged	\$30 cost of mold each, 11 set x2	660
	\$15 fitting fee (not charged on remakes) x22	330
Repair costs (after warranty expires) Loss or damage deductible	Most have 3 year warranty –@ \$85 per repair if not under warranty, parents pay Some aids have deductible, choose one without, or parent pays deductible	
Batteries	2 batteries/week \$1 each X 156 weeks	312
Cost over "A Sound Start" three year period per child (binaural fit)		4135
Cost per year for province assuming 120 babies fit:		496,200

Some assumptions in the above:

Back-up aids ordered to allow one set per 3 children fit.

Program covers all routine costs in first 3 years following fit.

Hearing aids will be at least programmable to allow flexibility of fit

Included in the hearing aid overall cost is the cost of earmold replacement due to growth. In the first few months, rapid growth may result in need for replacement every two weeks, reducing in frequency as the infant gets older. Estimates suggest an average of 20 earmolds over the first three years. Frequency of replacement is also a factor of severity of hearing loss, as the stronger hearing aids are more prone to feedback with even slight change in shape of ear canal. If the earmolds are not replaced, the hearing aid must be turned down or cannot be worn, making it ineffective. Travel for frequent earmold replacement may also be a burden if families do not have close local service. This will need to be considered when designing local implementation plans.

Hearing aids work well in quiet or close listening situations. For communication over distances or in noisy situations, such as the car or pre-school programs, use of FM systems improves the infants' ability to pick out the voices they need to hear from other noises. FM systems were not included in the budget, but may be available through partnership with B.C. Family Hearing Resource Centre Pre-school FM Program, assuming this program continues to be adequately funded for this service.

3. Intervention Costs:

Intervention services for babies who are found to have a hearing loss will be multidisciplinary, and include speech/language pathologists, infant development workers, pre-school teachers, and other support as required for four years prior to entering the school system. Costs for the 120 babies identified annually, therefore, escalate for the first 4 years, and then stabilize as children enter the school system. Calculations of the number of hours annually are shown in the summary table below. (The detailed calculations to determine total intervention hours are appended to this document. Again, the table below does not phase them to account for implementation by health authority, but this adjustment is done in the detailed costings appended.)

Intervention Budget - Speech/Language Pathologists, Infant Development Workers, Teachers	Yr 1	Yr 2	Yr 3	Yr 4
# children receiving Intervention Services	120	240	360	480
Therapy (# hrs): New Cases at	4,527	4,527	4,527	4,527
Therapy (# hrs): Ongoing Cases		4,311	6,678	7,857
Therapy (# hours) ¹⁰	4,527	8,838	11,205	12,384
ESL and Multiple Needs children ³ (# additional hrs)	604	1,178	1,494	1,651
Travel (#additional hrs) ⁴	4,527	8,838	11,205	12,389
Total Hrs Intervention	9,658	18,854	23,904	26,429
Total Average Hours per Child	80	79	66	55
Total Hours per child including paid vacation, nsra's, etc.	114	112	94	78
Total annual hours	13,714	26,773	33,944	37,529

Total intervention hours were then applied to the hearing loss population of each health authority to determine allocations. For the purpose of this costing, intervention dollars for children born at B.C. Women's Hospital are shown in the PHSA. When home health authorities are determined, the funds will be reallocated accordingly. Materials and equipment are estimated at \$40,000 annually, apportioned based on the percentage of children within the health authority.

4. Public/Professional Education:

One time costs for web development to educate the public and the professions about the program are estimated at \$25,000. An annual budget to promote the program province-wide is planned by estimating costs at \$1 per baby screened.

5. Training: Servicing newborns with hearing loss is a new development in diagnostic and habilitative audiology and intervention practices in B.C. Because most specialized services to date have been centred in regional audiology centre facilities or provincial interventions programs, training programs will be essential to ensure service providers have the required competencies in assessment, hearing aid fitting and intervention, for infants. Training was costed based on paying a professional to train both Public Health Audiologists as well as intervention staff. It was estimated using the number of audiologists in the province and an estimate of the number of interventionists needed to support this program. Training of the screeners will be done by the regional coordinators. Training frequency was estimated at two weeks in the first year, decreasing to one week annually thereafter.

6. Outcomes and Evaluation:

One time costs to develop a screening module, linkages to existing databases, and develop a provincial hearing loss registry are estimated at \$350,000. Computer hardware required at each screening site (65 sites) for data entry is estimated at \$4,000 per site. As well, a full time data manager/analyst will be required annually.

7. Health Authority Infrastructure and Support:

For the first year of the program, each health authority will require one full-time regional coordinator for program planning and implementation. Once the program is up and running, a 0.5 FTE coordinator is expected to be sufficient for each region. However, a full-time provincial coordinator will administer the full program through the PHSA. For each authority, 0.5 FTE is required for administrative support and data entry. In addition, local centre coordination and support will be provided by 0.2 FTE per 3,000 births.

Costing Summary:

Costs of a provincial program for early hearing detection and intervention are summarized in the following table. Details by health authority follow.

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Average Annual Cost
	\$	\$	\$	\$	\$	
1. a) Screening - Total Number of Babies	23,208	38,135	38,135	38,135	38,135	
- Total Operating Cost	\$ 928,320	\$ 1,525,384	\$ 1,525,384	\$ 1,525,384	\$ 1,525,384	\$ 40 per screen
b) Screening Equipment Costs & Maintenance	\$ 2,275,000	\$ 455,000	\$ 455,000	\$ 455,000	\$ 455,000	
c) Regional Centre Equipment Costs & Maintenance	\$ 703,118	\$ 140,624	\$ 140,624	\$ 140,624	\$ 140,624	
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification						
a) Hearing Risk Monitoring:						
- No. of at risk children	1,381	3,650	5,919	6,807	6,807	
- Total Cost	\$ 79,439	\$ 190,260	\$ 288,404	\$ 326,820	\$ 326,820	\$ 48 per high risk child
b) Diagnostic and hearing aid assessments						
- Number of Children	696	1,217	1,337	1,384	1,384	
- Total Cost	\$ 136,560	\$ 284,082	\$ 373,988	\$ 420,622	\$ 420,622	\$ 196 per child yr 1 \$ 304 per child yr 5 due to cumulative effects of more intensive follow up of hearing impaired children identified prior two years
c) Amplification (Hearing Aid Cost)	\$ 301,855	\$ 496,200	\$ 496,200	\$ 496,200	\$ 496,200	\$4,135 per Hearing Aid
3. Intervention - Total Cases	73	193	313	433	480	
- Total Labour Cost	\$ 339,990	\$ 880,943	\$ 1,247,708	\$ 1,442,225	\$ 1,528,810	\$3,185 per child
- Total Materials and Equip.	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000	\$ 40,000	
4. Public/Professional Education	\$ 23,208	\$ 63,135	\$ 38,135	\$ 38,135	\$ 38,135	
5. Training	\$ 227,493	\$ 132,496	\$ 132,496	\$ 132,496	\$ 132,496	
6. Outcomes and Evaluation	\$ -	\$ 680,000	\$ 70,000	\$ 70,000	\$ 70,000	
7. Health Authority Infrastructure Support	\$ 822,487	\$ 793,554	\$ 732,754	\$ 732,754	\$ 732,754	
8. Total Program	\$ 5,877,470	\$ 5,681,679	\$ 5,540,693	\$ 5,820,260	\$ 5,906,845	

The annual allocation by region is as follows:

Total Allocation By Health Authority

Health Authority	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	\$	\$	\$	\$	\$
Vancouver Coastal	499,039	655,684	661,151	713,984	761,759
Interior	1,211,896	843,141	847,660	868,278	868,278
North	691,977	578,166	552,333	601,348	613,477
Vancouver Island	1,162,083	806,857	851,716	872,334	872,334
Frasers	1,945,142	1,602,034	1,705,881	1,753,181	1,753,181
PHSA (intervention costs to be regionalized when data available)	367,333	1,195,795	921,953	1,011,135	1,037,817
All	5,877,470	5,681,679	5,540,693	5,820,260	5,906,845

Detailed Costing Allocations By Health Authority

1. Provincial Total
2. Vancouver Coastal Health Authority
3. Interior Health Authority
4. Northern Health Authority
5. Vancouver Island Health Authority
6. Fraser Health Authority
7. Provincial Health Services Authority
- 8.** Detailed Calculations to Determine Total Intervention Hours

Summary, EHDI-BC, Budget Estimates July 2004
 Provincial Total

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 5	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)		23,208		38,135		38,135		38,135		38,135
Cost per Case		\$ 40		\$ 40		\$ 40		\$ 40		\$ 40
Total Screening Operating Costs		\$ 928,320		\$ 1,525,384		\$ 1,525,384		\$ 1,525,384		\$ 1,525,384
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 2,275,000		\$ 455,000		\$ 455,000		\$ 455,000		\$ 455,000
Maintenance, Replacement, and Repair										
Total Screening Equipment Costs		\$ 2,275,000		\$ 455,000		\$ 455,000		\$ 455,000		\$ 455,000
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equipped Centres		11								
Number of Partially Equipped Centres		4								
Total Equipment Cost		\$ 703,118								
Maintenance, Replacement, and Repair				140,624		140,624		140,624		140,624
Total Regional Centre Equipment Costs		\$ 703,118		\$ 140,624		\$ 140,624		\$ 140,624		\$ 140,624
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children		1,381		3,650		5,919		6,807		6,807
No. of appointments for at risk children		1,837		4,399		6,668		7,556		7,556
Number of hours for total screening in year		1,949		4,669		7,077		8,020		8,020
Total FTE and cost for high risk monitoring	1.04	\$ 79,439	2.48	\$ 190,260	3.77	\$ 288,404	4.27	\$ 326,820	4.27	\$ 326,820
b) Diagnostic Assessment										
Number of Children		696		1,217		1,337		1,384		1,384
Total hours diagnostics		3,351		6,971		9,177		10,322		10,322
Total FTE and cost for diagnostics	1.78	\$ 136,560	3.71	\$ 284,082	4.88	\$ 373,988	5.49	\$ 420,622	5.49	\$ 420,622
c) Amplification										
Hearing Aid cost per case newly diagnosed	\$ 4,135									
Total Hearing Aid cost		\$ 301,855		\$ 496,200		\$ 496,200		\$ 496,200		\$ 496,200
Total Audiology Cost	2.82	\$ 517,854	6.19	\$ 970,543	8.65	\$ 1,158,592	9.76	\$ 1,243,642	9.76	\$ 1,243,642
3. Intervention										
Number of Children, Newly Diagnosed Plus Ongoing		73		193		313		433		480
Total Hours Annually		8,343		21,617		30,617		35,390		37,515
Total Cost (may be SLP, IDP, TDHH)	4.44	\$ 339,990	11.50	\$ 880,943	16.29	\$ 1,247,708	18.83	\$ 1,442,225	19.96	\$ 1,528,810
Materials and Equipment		\$ 40,000		\$ 40,000		\$ 40,000		\$ 40,000		\$ 40,000
Total Intervention Cost	4.44	\$ 379,990	11.50	\$ 920,943	16.29	\$ 1,287,708	18.83	\$ 1,482,225	19.96	\$ 1,568,810
4. Public/Professional Education										
Web Development		\$ -		\$ 25,000		\$ -		\$ -		\$ -
Promotion		\$ 23,208		\$ 38,135		\$ 38,135		\$ 38,135		\$ 38,135
Total Public/Professional Education		\$ 23,208		\$ 63,135		\$ 38,135		\$ 38,135		\$ 38,135
5. Training										
Audiology Training (staff time)		\$ 162,493		\$ 81,246		\$ 81,246		\$ 81,246		\$ 81,246
Travel		\$ 42,000		\$ 36,750		\$ 36,750		\$ 36,750		\$ 36,750
Trainer fees and travel		\$ 23,000		\$ 14,500		\$ 14,500		\$ 14,500		\$ 14,500
Total Training Cost		\$ 227,493		\$ 132,496		\$ 132,496		\$ 132,496		\$ 132,496
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -		\$ 350,000		\$ -		\$ -		\$ -
Screening Site Computer Hardware		\$ -		\$ 260,000		\$ -		\$ -		\$ -
Data Manager		\$ -		\$ 70,000		\$ 70,000		\$ 70,000		\$ 70,000
Total Outcomes and Evaluation Costs		\$ -		\$ 680,000		\$ 70,000		\$ 70,000		\$ 70,000
7. Health Authority Infrastructure Support										
Regional Coordinator	4.50	\$ 360,000	4.26	\$ 340,800	3.50	\$ 280,000	3.50	\$ 280,000	3.50	\$ 280,000
Administrative Support & Data Entry	2.00	\$ 160,000	3.00	\$ 240,000	3.00	\$ 240,000	3.00	\$ 240,000	3.00	\$ 240,000
Local Centre Coordination/Support	1.61	\$ 122,487	2.17	\$ 164,754	2.17	\$ 164,754	2.17	\$ 164,754	2.17	\$ 164,754
Non Labour Office Support & Start-up		\$ 180,000		\$ 48,000		\$ 48,000		\$ 48,000		\$ 48,000
Total Infrastructure Support	8.11	\$ 822,487	9.43	\$ 793,554	8.67	\$ 732,754	8.67	\$ 732,754	8.67	\$ 732,754
8. Total		\$ 5,877,470		\$ 5,681,679		\$ 5,540,693		\$ 5,820,260		\$ 5,906,845

Vancouver Coastal Health Authority EHD-BC, Budget Estimates July 2004

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 5	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)			4,815		4,815		4,815		4,815	
Cost per Case		\$ 40	\$ 40		\$ 40		\$ 40		\$ 40	
Total Screening Operating Costs		\$ -	\$ 192,584		\$ 192,584		\$ 192,584		\$ 192,584	
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 300,000								
Maintenance, Replacement, and Repair			\$ 60,000		\$ 60,000		\$ 60,000		\$ 60,000	
Total Screening Equipment Cost		\$ 300,000	\$ 60,000		\$ 60,000		\$ 60,000		\$ 60,000	
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equiped Centres		2								
Equipment Cost per full centre		\$ 55,937								
Number of Partially Equipped Centres		0								
Equipment Cost per Partial Centre		0								
Total Equipment Cost		\$ 111,874								
Maintenance, Replacement, and Repair			22,375		22,375		22,375		22,375	
Total Regional Centre Equipment Costs		\$ 111,874	\$ 22,375		\$ 22,375		\$ 22,375		\$ 22,375	
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children			286		573		859		859	
No. of appointments for at risk children		0	381		667		954		954	
Number of hours for total screening in year		0	404		708		1013		1013	
Total FTE and cost for high risk monitoring	0.00	\$ -	0.22	16,480	0.38	28,871	0.54	41,262	0.54	41,262
b) Diagnostic Assessment										
Number of Children		0	144		159		174		174	
Total hours diagnostics		0	695		999		1,303		1,303	
Total FTE and cost for diagnostics	0.00	\$ -	0.37	28,323	0.53	40,715	0.69	53,105	0.69	53,105
c) Amplification										
Hearing Aid cost per case newly diagnosed	4,135									
Total Hearing Aid cost		\$ -	\$ 62,025		\$ 62,025		\$ 62,025		\$ 62,025	
Total Audiology Cost	0.00	\$ -	0.59	\$ 106,828	0.91	\$ 131,611	1.23	\$ 156,392	1.23	\$ 156,392
3. Intervention										
Number of Children, Newly Diagnosed Plus Ongoing			15		30		45		60	
Total Hours Annually		-	1,673		2,829		3,517		4,689	
Total Cost (may be SLP, IDP, TDHH)	0.00	\$ -	0.89	\$ 68,190	1.51	\$ 115,273	1.87	\$ 143,326	2.50	\$ 191,101
Materials and Equipment		\$ 5,000	\$ 5,000		\$ 5,000		\$ 5,000		\$ 5,000	
Total Intervention Cost	0.00	\$ 5,000	0.89	\$ 73,190	1.51	\$ 120,273	1.87	\$ 148,326	2.50	\$ 196,101
4. Public/Professional Education										
Web Development										
Promotion		\$ -	\$ 4,815		\$ 4,815		\$ 4,815		\$ 4,815	
Total Public/Professional Education		\$ -	\$ 4,815		\$ 4,815		\$ 4,815		\$ 4,815	
5. Training										
Audiology Training (staff time)		\$ 29,165	\$ 14,583		\$ 14,583		\$ 14,583		\$ 14,583	
Travel		\$ -	\$ -		\$ -		\$ -		\$ -	
Trainer fees and travel		\$ 3,000	\$ 1,500		\$ 1,500		\$ 1,500		\$ 1,500	
Total Training Cost		\$ 32,165	\$ 16,083		\$ 16,083		\$ 16,083		\$ 16,083	
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -	\$ -		\$ -		\$ -		\$ -	
Screening Site Computer Hardware Data Manager			\$ 36,000							
Total Outcomes and Evaluation Costs			\$ -	\$ 36,000		\$ -	\$ -		\$ -	\$ -
7. Health Authority Infrastructure Support										
Regional Coordinator	0.25	\$ 20,000	0.88	\$ 70,400	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Administrative Support & Data Entry		\$ -	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Local Centre Coordination/Support	0.00	\$ -	0.33	\$ 25,410	0.33	\$ 25,410	0.33	\$ 25,410	0.33	\$ 25,410
Non Labour Office Support & Start-up		\$ 30,000	\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000	
Total Infrastructure Support	0.25	\$ 50,000	1.71	\$ 143,810	1.33	\$ 113,410	1.33	\$ 113,410	1.33	\$ 113,410
8. Total		\$ 499,039	\$ 655,684		\$ 661,151		\$ 713,984		\$ 761,759	

Interior Health Authority EHDI-BC, Budget Estimates July 2004

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 5	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)		5,269		5,269		5,269		5,269		5,269
Cost per Case		\$ 40		\$ 40		\$ 40		\$ 40		\$ 40
Total Screening Operating Costs		\$ 210,760		\$ 210,760		\$ 210,760		\$ 210,760		\$ 210,760
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 460,000								
Maintenance, Replacement, and Repair				\$ 92,000		\$ 92,000		\$ 92,000		\$ 92,000
Total Screening Equipment Cost		\$ 460,000		\$ 92,000		\$ 92,000		\$ 92,000		\$ 92,000
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equiped Centres		2								
Equipment Cost per full centre		\$ 55,937								
Number of Partially Equipped Centres		0								
Equipment Cost per Partial Centre		0								
Total Equipment Cost		\$ 111,874								
Maintenance, Replacement, and Repair				22,375		22,375		22,375		22,375
Total Regional Centre Equipment Costs		\$ 111,874		\$ 22,375		\$ 22,375		\$ 22,375		\$ 22,375
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children		314		627		941		941		941
No. of appointments for at risk children		417		730		1044		1044		1044
Number of hours for total screening in year		443		775		1108		1108		1108
Total FTE and cost for high risk monitoring	0.24	\$ 18,035	0.41	31,596	0.59	45,156	0.59	45,156	0.59	45,156
b) Diagnostic Assessment										
Number of Children		158		175		192		192		192
Total hours diagnostics		761		1,093		1,426		1,426		1,426
Total FTE and cost for diagnostics	0.40	\$ 31,012	0.58	44,558	0.76	58,117	0.76	58,117	0.76	58,117
c) Amplification										
Hearing Aid cost per case newly diagnosed	4,135									
Total Hearing Aid cost		\$ 70,295		\$ 70,295		\$ 70,295		\$ 70,295		\$ 70,295
Total Audiology Cost	0.64	\$ 119,343	0.99	\$ 146,449	1.35	\$ 173,568	1.35	\$ 173,568	1.35	\$ 173,568
3. Intervention										
Number of Children, Newly Diagnosed Plus Ongoing		17		34		51		68		68
Total Hours Annually		1,943		3,793		4,809		5,315		5,315
Total Cost (may be SLP, IDP, TDHH)	1.03	\$ 79,176	2.02	\$ 154,564	2.56	\$ 195,964	2.83	\$ 216,581	2.83	\$ 216,581
Materials and Equipment		\$ 5,667		\$ 5,667		\$ 5,667		\$ 5,667		\$ 5,667
Total Intervention Cost	1.03	\$ 84,842	2.02	\$ 160,231	2.56	\$ 201,630	2.83	\$ 222,248	2.83	\$ 222,248
4. Public/Professional Education										
Web Development										
Promotion		\$ 5,269		\$ 5,269		\$ 5,269		\$ 5,269		\$ 5,269
Total Public/Professional Education		\$ 5,269		\$ 5,269		\$ 5,269		\$ 5,269		\$ 5,269
5. Training										
Audiology Training (staff time)		\$ 24,999		\$ 12,499		\$ 12,499		\$ 12,499		\$ 12,499
Travel		\$ 12,000		\$ 10,500		\$ 10,500		\$ 10,500		\$ 10,500
Trainer fees and travel		\$ 5,000		\$ 3,250		\$ 3,250		\$ 3,250		\$ 3,250
Total Training Cost		\$ 41,999		\$ 26,249		\$ 26,249		\$ 26,249		\$ 26,249
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -		\$ -		\$ -		\$ -		\$ -
Screening Site Computer Hardware Data Manager				\$ 64,000						
Total Outcomes and Evaluation Costs				\$ 64,000		\$ -		\$ -		\$ -
7. Health Authority Infrastructure Support										
Regional Coordinator	1.00	\$ 80,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Administrative Support & Data Entry	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Local Centre Coordination/Support	0.37	\$ 27,809	0.37	\$ 27,809	0.37	\$ 27,809	0.37	\$ 27,809	0.37	\$ 27,809
Non Labour Office Support & Start-up		\$ 30,000		\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000
Total Infrastructure Support	1.87	\$ 177,809	1.37	\$ 115,809	1.37	\$ 115,809	1.37	\$ 115,809	1.37	\$ 115,809
8. Total		\$ 1,211,896		\$ 843,141		\$ 847,660		\$ 868,278		\$ 868,278

Northern Health Authority EHDl-BC, Budget Estimates July 2004

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 4	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)				3,194		3,194		3,194		3,194
Cost per Case		\$ 40		\$ 40		\$ 40		\$ 40		\$ 40
Total Screening Operating Costs		\$ -		\$ 127,760		\$ 127,760		\$ 127,760		\$ 127,760
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 475,000								
Maintenance, Replacement, and Repair				\$ 95,000		\$ 95,000		\$ 95,000		\$ 95,000
Total Screening Equipment Cost		\$ 475,000		\$ 95,000		\$ 95,000		\$ 95,000		\$ 95,000
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equipped Centres		2								
Equipment Cost per full centre		\$ 55,937								
Number of Partially Equipped Centres		1								
Equipment Cost per Partial Centre		15937								
Total Equipment Cost		\$ 127,811								
Maintenance, Replacement, and Repair				25,562		25,562		25,562		25,562
Total Regional Centre Equipment Costs		\$ 127,811		\$ 25,562		\$ 25,562		\$ 25,562		\$ 25,562
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children				190		380		570		570
No. of appointments for at risk children		0		253		443		633		633
Number of hours for total screening in year		0		268		470		672		672
Total FTE and cost for high risk monitoring	0.00	\$ -	0.14	10,933	0.25	19,153	0.36	27,373	0.36	27,373
b) Diagnostic Assessment										
Number of Children		0		96		106		116		116
Total hours diagnostics				461		461		864		864
Total FTE and cost for diagnostics	0.00	\$ -	0.25	18,787	0.25	18,787	0.46	35,230	0.46	35,230
c) Amplification										
Hearing Aid cost per case newly diagnosed	4,135									
Total Hearing Aid cost		\$ -		\$ 41,350		\$ 41,350		\$ 41,350		\$ 41,350
Total Audiology Cost	0.00	\$ -	0.39	\$ 71,069	0.50	\$ 79,290	0.82	\$ 103,953	0.82	\$ 103,953
3. Intervention										
Number of Children, Newly Diagnosed Plus Ongoing				10		20		30		40
Total Hours Annually				1,143		2,231		2,829		3,126
Total Cost (may be SLP, IDP, TDHH)	0.00	\$ -	0.61	\$ 46,574	1.19	\$ 90,920	1.51	\$ 115,273	1.66	\$ 127,401
Materials and Equipment		\$ 3,333		\$ 3,333		\$ 3,333		\$ 3,333		\$ 3,333
Total Intervention Cost	0.00	\$ 3,333	0.61	\$ 49,907	1.19	\$ 94,253	1.51	\$ 118,606	1.66	\$ 130,734
4. Public/Professional Education										
Web Development										
Promotion		\$ -		\$ 3,194		\$ 3,194		\$ 3,194		\$ 3,194
Total Public/Professional Education		\$ -		\$ 3,194		\$ 3,194		\$ 3,194		\$ 3,194
5. Training										
Audiology Training (staff time)		\$ 20,832		\$ 10,416		\$ 10,416		\$ 10,416		\$ 10,416
Travel		\$ 10,000		\$ 8,750		\$ 8,750		\$ 8,750		\$ 8,750
Trainer fees and travel		\$ 5,000		\$ 3,250		\$ 3,250		\$ 3,250		\$ 3,250
Total Training Cost		\$ 35,832		\$ 22,416		\$ 22,416		\$ 22,416		\$ 22,416
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -		\$ -		\$ -		\$ -		\$ -
Screening Site Computer Hardware Data Manager				\$ 48,000		\$ -		\$ -		\$ -
Total Outcomes and Evaluation Costs				\$ 48,000		\$ -		\$ -		\$ -
7. Health Authority Infrastructure Support										
Regional Coordinator	0.25	\$ 20,000	0.88	\$ 70,400	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Administrative Support & Data Entry		\$ -	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Local Centre Coordination/Support	0.00	\$ -	0.22	\$ 16,857	0.22	\$ 16,857	0.22	\$ 16,857	0.22	\$ 16,857
Non Labour Office Support & Start-up		\$ 30,000		\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000
Total Infrastructure Support	0.25	\$ 50,000	1.60	\$ 135,257	1.22	\$ 104,857	1.22	\$ 104,857	1.22	\$ 104,857
8. Total		\$ 691,977		\$ 578,166		\$ 552,333		\$ 601,348		\$ 613,477

Vancouver Island Health Authority EHDI-BC, Budget Estimates July 2004

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 5	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)		5,335		5,335		5,335		5,335		5,335
Cost per Case		\$ 40		\$ 40		\$ 40		\$ 40		\$ 40
Total Screening Operating Costs		\$ 213,400		\$ 213,400		\$ 213,400		\$ 213,400		\$ 213,400
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 350,000								
Maintenance, Replacement, and Repair				\$ 70,000		\$ 70,000		\$ 70,000		\$ 70,000
Total Screening Equipment Cost		\$ 350,000		\$ 70,000		\$ 70,000		\$ 70,000		\$ 70,000
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equiped Centres		2								
Equipment Cost per full centre		\$ 55,937								
Number of Partially Equipped Centres		2								
Equipment Cost per Partial Centre		\$ 15,937								
Total Equipment Cost		\$ 143,748								
Maintenance, Replacement, and Repair				28,750		28,750		28,750		28,750
Total Regional Centre Equipment Costs		\$ 143,748		\$ 28,750		\$ 28,750		\$ 28,750		\$ 28,750
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children		317		635		952		952		952
No. of appointments for at risk children		422		740		1057		1057		1057
Number of hours for total screening in year		448		785		1122		1122		1122
Total FTE and cost for high risk monitoring	0.24	\$ 18,261	0.42	31,992	0.60	45,722	0.60	45,722	0.60	45,722
b) Diagnostic Assessment										
Number of Children		160		177		194		194		194
Total hours diagnostics		770		1,107		1,444		1,444		1,444
Total FTE and cost for diagnostics	0.41	\$ 31,379	0.59	45,116	0.77	58,845	0.77	58,845	0.77	58,845
c) Amplification										
Hearing Aid cost per case newly diagnosed	4,135									
Total Hearing Aid cost		\$ 70,295		\$ 70,295		\$ 70,295		\$ 70,295		\$ 70,295
Total Audiology Cost	0.65	\$ 119,935	1.01	\$ 147,403	1.37	\$ 174,861	1.37	\$ 174,861	1.37	\$ 174,861
3. Intervention										
Number of Children, Newly Diagnosed Plus Ongoing		17		34		51		68		68
Total Hours Annually		1,943		3,793		4,809		5,315		5,315
Total Cost (may be SLP, IDP, TDHH)	1.03	\$ 79,176	2.02	\$ 154,564	2.56	\$ 195,964	2.83	\$ 216,581	2.83	\$ 216,581
Materials and Equipment		\$ 5,667		\$ 5,667		\$ 5,667		\$ 5,667		\$ 5,667
Total Intervention Cost	1.03	\$ 84,842	2.02	\$ 160,231	2.56	\$ 201,630	2.83	\$ 222,248	2.83	\$ 222,248
4. Public/Professional Education										
Web Development										
Promotion		\$ 5,335		\$ 5,335		\$ 5,335		\$ 5,335		\$ 5,335
Total Public/Professional Education		\$ 5,335		\$ 5,335		\$ 5,335		\$ 5,335		\$ 5,335
5. Training										
Audiology Training (staff time)		\$ 41,665		\$ 20,832		\$ 20,832		\$ 20,832		\$ 20,832
Travel		\$ 20,000		\$ 17,500		\$ 17,500		\$ 17,500		\$ 17,500
Trainer fees and travel		\$ 5,000		\$ 3,250		\$ 3,250		\$ 3,250		\$ 3,250
Total Training Cost		\$ 66,665		\$ 41,582		\$ 41,582		\$ 41,582		\$ 41,582
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -		\$ -		\$ -		\$ -		\$ -
Screening Site Computer Hardware				\$ 24,000						
Data Manager										
Total Outcomes and Evaluation Costs				\$ 24,000		\$ -		\$ -		\$ -
7. Health Authority Infrastructure Support										
Regional Coordinator	1.00	\$ 80,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Administrative Support & Data Entry	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Local Centre Coordination/Support	0.37	\$ 28,157	0.37	\$ 28,157	0.37	\$ 28,157	0.37	\$ 28,157	0.37	\$ 28,157
Non Labour Office Support & Start-up		\$ 30,000		\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000
Total Infrastructure Support	1.87	\$ 178,157	1.37	\$ 116,157	1.37	\$ 116,157	1.37	\$ 116,157	1.37	\$ 116,157
8. Total		\$ 1,162,083		\$ 806,857		\$ 851,716		\$ 872,334		\$ 872,334

Fraser Health Authority EHD-BC, Budget Estimates July 2004

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 5	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)		12,604		12,604		12,604		12,604		12,604
Cost per Case		\$ 40		\$ 40		\$ 40		\$ 40		\$ 40
Total Screening Operating Costs		\$ 504,160		\$ 504,160		\$ 504,160		\$ 504,160		\$ 504,160
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 520,000		\$ 104,000		\$ 104,000		\$ 104,000		\$ 104,000
Maintenance, Replacement, and Repair				\$ 104,000		\$ 104,000		\$ 104,000		\$ 104,000
Total Screening Equipment Cost		\$ 520,000		\$ 104,000		\$ 104,000		\$ 104,000		\$ 104,000
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equiped Centres		3								
Equipment Cost per full centre		\$ 55,937								
Number of Partially Equipped Centres		0								
Equipment Cost per Partial Centre		0								
Total Equipment Cost		\$ 167,811								
Maintenance, Replacement, and Repair				33,562		33,562		33,562		33,562
Total Regional Centre Equipment Costs		\$ 167,811		\$ 33,562		\$ 33,562		\$ 33,562		\$ 33,562
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children		750		1,500		2,250		2,250		2,250
No. of appointments for at risk children		997		1747		2497		2497		2497
Number of hours for total screening in year		1059		1855		2651		2651		2651
Total FTE and cost for high risk monitoring	0.56	\$ 43,142	0.99	75,580	1.41	108,018	1.41	108,018	1.41	108,018
b) Diagnostic Assessment										
Number of Children		378		417		456		456		456
Total hours diagnostics		1,820		2,616		3,411		3,411		3,411
Total FTE and cost for diagnostics	0.97	\$ 74,169	1.39	106,588	1.82	139,021	1.82	139,021	1.82	139,021
c) Amplification										
Hearing Aid cost per case newly diagnosed	4,135									
Total Hearing Aid cost		\$ 161,265		\$ 161,265		\$ 161,265		\$ 161,265		\$ 161,265
Total Audiology Cost	1.53	\$ 278,576	2.38	\$ 343,433	3.23	\$ 408,305	3.23	\$ 408,305	3.23	\$ 408,305
3. Intervention										
Number of Children, Newly Diagnosed Plus Ongoing		39		78		117		156		156
Total Hours Annually		4,457		8,701		11,032		12,192		12,192
Total Cost (may be SLP, IDP, TDHH)	2.37	\$ 181,638	4.63	\$ 354,588	5.87	\$ 449,564	6.49	\$ 496,863	6.49	\$ 496,863
Materials and Equipment		\$ 13,000		\$ 13,000		\$ 13,000		\$ 13,000		\$ 13,000
Total Intervention Cost	2.37	\$ 194,638	4.63	\$ 367,588	5.87	\$ 462,564	6.49	\$ 509,863	6.49	\$ 509,863
4. Public/Professional Education										
Web Development		\$ 12,604		\$ 12,604		\$ 12,604		\$ 12,604		\$ 12,604
Promotion		\$ 12,604		\$ 12,604		\$ 12,604		\$ 12,604		\$ 12,604
Total Public/Professional Education		\$ 12,604		\$ 12,604		\$ 12,604		\$ 12,604		\$ 12,604
5. Training										
Audiology Training (staff time)		\$ 45,831		\$ 22,916		\$ 22,916		\$ 22,916		\$ 22,916
Travel		\$ 5,000		\$ 3,250		\$ 3,250		\$ 3,250		\$ 3,250
Trainer fees and travel		\$ 5,000		\$ 3,250		\$ 3,250		\$ 3,250		\$ 3,250
Total Training Cost		\$ 50,831		\$ 26,166		\$ 26,166		\$ 26,166		\$ 26,166
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -		\$ -		\$ -		\$ -		\$ -
Screening Site Computer Hardware Data Manager				\$ 56,000						
Total Outcomes and Evaluation Costs		\$ -		\$ 56,000		\$ -		\$ -		\$ -
7. Health Authority Infrastructure Support										
Regional Coordinator	1.00	\$ 80,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Administrative Support & Data Entry	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Local Centre Coordination/Support	0.88	\$ 66,521	0.88	\$ 66,521	0.88	\$ 66,521	0.88	\$ 66,521	0.88	\$ 66,521
Non Labour Office Support & Start-up		\$ 30,000		\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000
Total Infrastructure Support	2.38	\$ 216,521	1.88	\$ 154,521	1.88	\$ 154,521	1.88	\$ 154,521	1.88	\$ 154,521
8. Total		1,945,142		1,602,034		1,705,881		1,753,181		1,753,181

Provincial Health Services Authority EHD-BC, Budget Estimates July 2004

	Yr 1		Yr 2		Yr 3		Yr 4		Yr 5	
	FTE	\$	FTE	\$	FTE	\$	FTE	\$	FTE	\$
1. a) Screening										
Number of Babies (Excludes babies born at C&W)			6,918		6,918		6,918		6,918	
Cost per Case		\$ 40	\$ 40		\$ 40		\$ 40		\$ 40	
Total Screening Operating Costs		\$ -	\$ 276,720		\$ 276,720		\$ 276,720		\$ 276,720	
b) Screening Equipment Costs										
Equipment Cost (one time)		\$ 170,000								
Maintenance, Replacement, and Repair			\$ 34,000		\$ 34,000		\$ 34,000		\$ 34,000	
Total Screening Equipment Cost		\$ 170,000	\$ 34,000		\$ 34,000		\$ 34,000		\$ 34,000	
c) Regional Audio. Diag. Centre Equip.										
Number of Fully equiped Centres		0								
Equipment Cost per full centre		\$ 55,937								
Number of Partially Equipped Centres		1								
Equipment Cost per Partial Centre		\$ 40,000								
Total Equipment Cost		\$ 40,000								
Maintenance, Replacement, and Repair			8,000		8,000		8,000		8,000	
Total Regional Centre Equipment Costs		\$ 40,000	\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000	
2. Hearing Risk Monitoring, Diagnostic Assessment, and Amplification										
a) Hearing Risk Monitoring:										
No. of at risk children			412		823		1235		1235	
No. of appointments for at risk children		0	547		959		1371		1371	
Number of hours for total screening in year		0	581		1018		1455		1455	
Total FTE and cost for high risk monitoring	0.00	\$ -	0.31	23,680	0.54	41,484	0.77	59,288	0.77	59,288
b) Diagnostic Assessment										
Number of Children		0	208		230		252		252	
Total hours diagnostics			999		1,436		1,872		1,872	
Total FTE and cost for diagnostics	0.00	\$ -	0.53	40,711	0.76	58,503	1.00	76,305	1.00	76,305
c) Amplification										
Hearing Aid cost per case newly diagnosed	4,135									
Total Hearing Aid cost		\$ -	\$ 90,970		\$ 90,970		\$ 90,970		\$ 90,970	
Total Audiology Cost	0.00	\$ -	0.84	\$ 155,361	1.31	\$ 190,957	1.77	\$ 226,563	1.77	\$ 226,563
3. Intervention (Needs to be Regionalized When Data Available)										
Number of Children, Newly Diagnosed Plus Ongoing			22		44		66		88	
Total Hours Annually			2,514		4,908		6,223		6,878	
Total Cost (may be SLP, IDP, TDHH)	0.00	\$ -	1.34	\$ 102,463	2.61	\$ 200,024	3.31	\$ 253,600	3.66	\$ 280,282
Materials and Equipment		\$ 7,333		\$ 7,333		\$ 7,333		\$ 7,333		\$ 7,333
Total Intervention Cost	0.00	\$ 7,333	1.34	\$ 109,796	2.61	\$ 207,357	3.31	\$ 260,933	3.66	\$ 287,615
4. Public/Professional Education										
Web Development			\$ 25,000							
Promotion		\$ -	\$ 6,918		\$ 6,918		\$ 6,918		\$ 6,918	
Total Public/Professional Education		\$ -	\$ 31,918		\$ 6,918		\$ 6,918		\$ 6,918	
5. Training										
Audiology Training (staff time)		\$ -	\$ -		\$ -		\$ -		\$ -	
Travel										
Trainer fees and travel										
Total Training Cost		\$ -	\$ -		\$ -		\$ -		\$ -	
6. Outcomes and Evaluation										
Screening Module, Database Linkages, Provincial Hearing Loss Registry (One Time)		\$ -	\$ 350,000		\$ -		\$ -		\$ -	
Screening Site Computer Hardware			\$ 32,000							
Data Manager			1.00	\$ 70,000	1.00	\$ 70,000	1.00	\$ 70,000	1.00	\$ 70,000
Total Outcomes and Evaluation Costs			1.00	452,000	1.00	70,000	1.00	70,000	1.00	70,000
7. Health Authority Infrastructure Support										
Provincial Coordinator	1.00	\$ 80,000	1.00	\$ 80,000	1.00	\$ 80,000	1.00	\$ 80,000	1.00	\$ 80,000
Administrative Support & Data Entry	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000	0.50	\$ 40,000
Local Centre Coordination/Support		\$ -	\$ -		\$ -		\$ -		\$ -	
Non Labour Office Support & Start-up		\$ 30,000	\$ 8,000		\$ 8,000		\$ 8,000		\$ 8,000	
Total Infrastructure Support	1.50	\$ 150,000	\$ 128,000		\$ 128,000		\$ 128,000		\$ 128,000	
8. Total		367,333	1,195,795		921,953		1,011,135		1,037,817	

Calculation of Intervention Hours

	Yr 1 Start Up Yr	Yr 2	Yr 3	Yr 4 and Ongoing years
# children receiving Intervention Services (cumulative cases) ^{2,7}	120	120 New 120 Ongoing	120 New 240 Ongoing	120 New 360 Ongoing
Therapy (# hrs) ¹⁰ : New Cases	4527	4527	4,527	4,527
Therapy (# hrs) ¹⁰ : Ongoing Cases	-	4311	4311 +2367	4311 +2367 +1179
Therapy (# hours) ¹⁰	4527	8838	11205	12389
ESL and Multiple Needs children ³ (# additional hrs)	604	1178	1494	1651
Travel (#additional hrs) ⁴	4527	8838	11205	12389
Total Hrs Intervention	9658	18854	23904	26429

Assumptions:

1. Start-Up Year: Assume 2/3 of the infants will be identified due to partial implementation of program.
2. Breakdown of New Cases by Hearing Loss: Based on prevalence of 3/1000. Within the 3/1000: 1/1000 unilateral hearing loss; 1/1000 permanent bilateral greater than 40 dB (20% severe; 20% profound); 1/1000 permanent bilateral less than 40 dB resulting in: 120 new cases each year (48: unilateral; 21: mild; 22: moderate; 22: severe; 7: profound)
3. ESL children are estimated at 25% of population; Children with Multiple Disabilities are estimated at 30% of population. There will be some children common to both. Overall estimate of ESL and Multiply Disabled children is 40%, requiring an additional .5 hour per session.
4. Travel time will vary widely across B.C. but is estimated at 1.5 hours per session. Interventionists provide service in the home. No costs for families to travel have been incorporated. Intervention services are optimally provided in the home.
5. Based on a single three-day (21 hrs) session for each Health Authority (5) provided by 2 trainers. Includes 6 hours preparation and 7 hrs travel time for each trainer. Health Authorities will be responsible for providing staffing costs and a facility for the training.
6. Based on \$1000 for 2 trainers for each Health Authority (5).
7. Note: Amount of service was calculated based on degree of hearing loss and amount of service needed. All service sessions were based on 1.5 hours (.5 hours preparation and 1.0 hours direct service). The summary budget excel spreadsheets calculated an average amount of service needed per child. Implementation will require consideration of the degree of hearing loss in allocating intervention resources.
8. Note: The Intervention budget reflects the best estimate of *additional* intervention hours needed to deliver direct client service. This does not include other support services (for example, social work, psychology) or administrative/clerical support.
9. Therapy equipment and materials was based on 30 Public Health Clinics plus 10 additional service sites (CHC, IDP, etc.). Cost @ \$1000 per site (additional therapy equipment and materials to support very young children and their families). Therapy equipment and materials will change over the first three years as the age of child increases. The subsequent year budgets are for replacement and new materials.
10. Calculations for Hours of Therapy:

Number of additional and total sessions by Degree of Hearing Loss					
Progressive Years of Service for Child	Unilateral # sessions*	Mild # sessions*	Moderate # sessions** (additional)	Sev-Profound # sessions** (additional)	Total
First Year (0-1 year)	5	6	52	52	115
Second Year (1-2 year)	2	6	52	52	112
Third Year (2-3 year)	1	4	26 (13)	52 (40)	58
Fourth Year (3-4 year)	1	2	12 (0)	36 (24)	39

* - all sessions are additional sessions to those already provided by interventionists. These are children with hearing losses that would not be detected until school entry or after without newborn hearing screening

** - Total sessions with the number of additional sessions in brackets. These children would have been on caseload at a later age and intervention is already partially covered through existing funding.

Calculations of Hours per Year of Program – Year 1				
Type: Year 1	# children	# hrs	Session/yr	Total hrs
Uni	48	1.5	5	360
Mild	21	1.5	6	189
Mod	22	1.5	52	1716
Sev/pro	29	1.5	52	2262
Hours for Children in Year 1 of the program				4527

Calculations of Hours per Year of Program – Year 2				
Type: Year 2	# children	# hrs	Session/yr	Total hrs
Uni	48	1.5	2	144
Mild	21	1.5	6	189
Mod	22	1.5	52	1716
Sev/pro	29	1.5	52	2262
Hours for children in 2 nd year of the program				4311

Calculations of Hours per Year of Program – Year 3				
Type: Year 3	# children	# hrs	Session/yr	Total hrs
Uni	48	1.5	1	72
Mild	21	1.5	4	126
Mod	22	1.5	13	429
Sev/pro	29	1.5	40	1740
Hours for children in 3 rd year of the program				2367

Calculations of Hours per Year of Program – Year 4 and Ongoing				
Type: Year 4	# children	# hrs	Session/yr	Total hrs
Uni	48	1.5	1	72
Mild	21	1.5	2	63
Mod	22	1.5	0	0
Sev/pro	29	1.5	24	1044
Hours for children in 4 th year of the program				1179

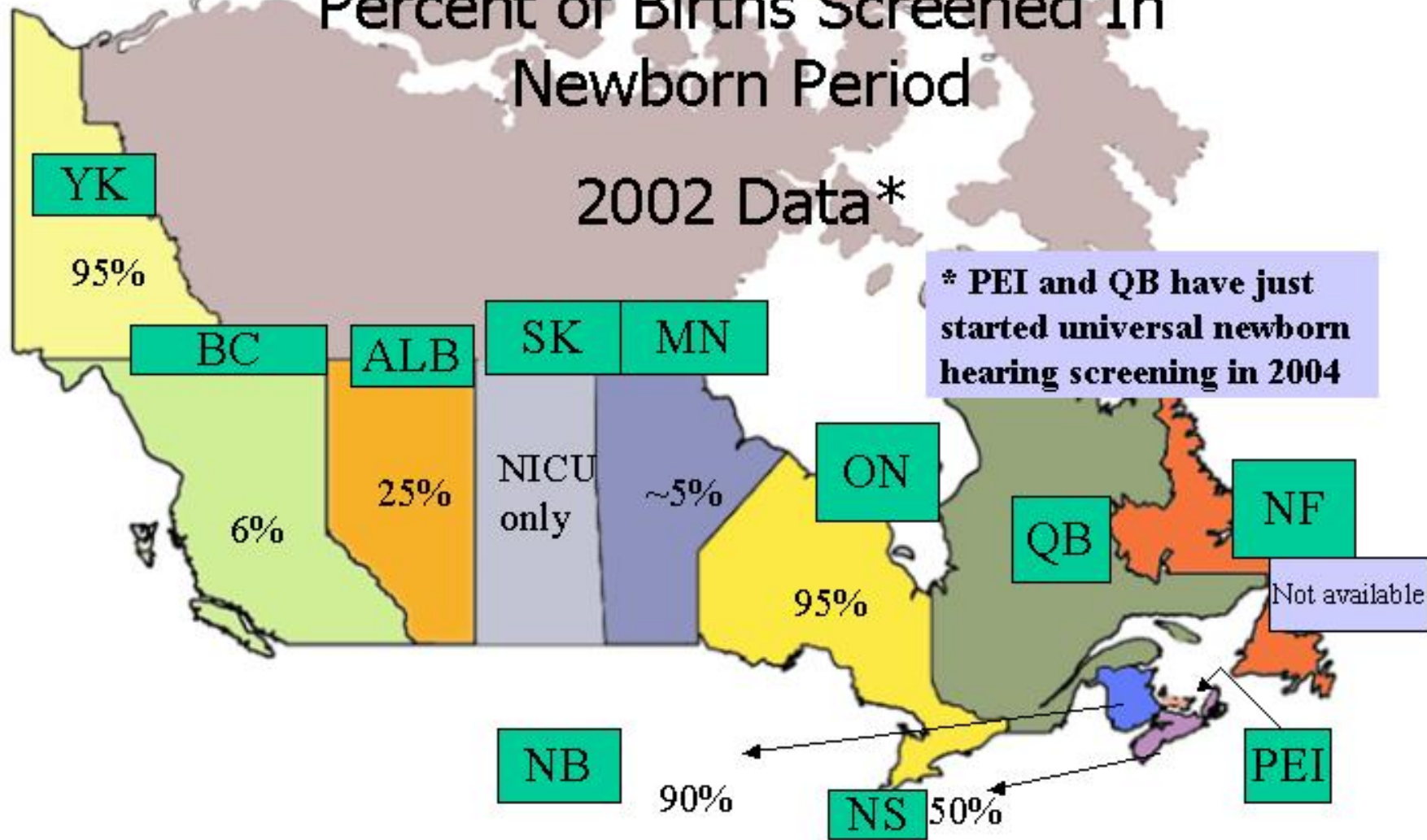
Year of Program/ Cumulative hrs	Yr1	Yr2	Yr3	Yr4
Yr1	4527	4527	4527	4527
Yr2	-	4311	4311	4311
Yr3	-	-	2367	2367
Yr4	-	-	-	1179

Appendix J

Percent of Births Screened In Newborn Period

2002 Data*

* PEI and QB have just started universal newborn hearing screening in 2004



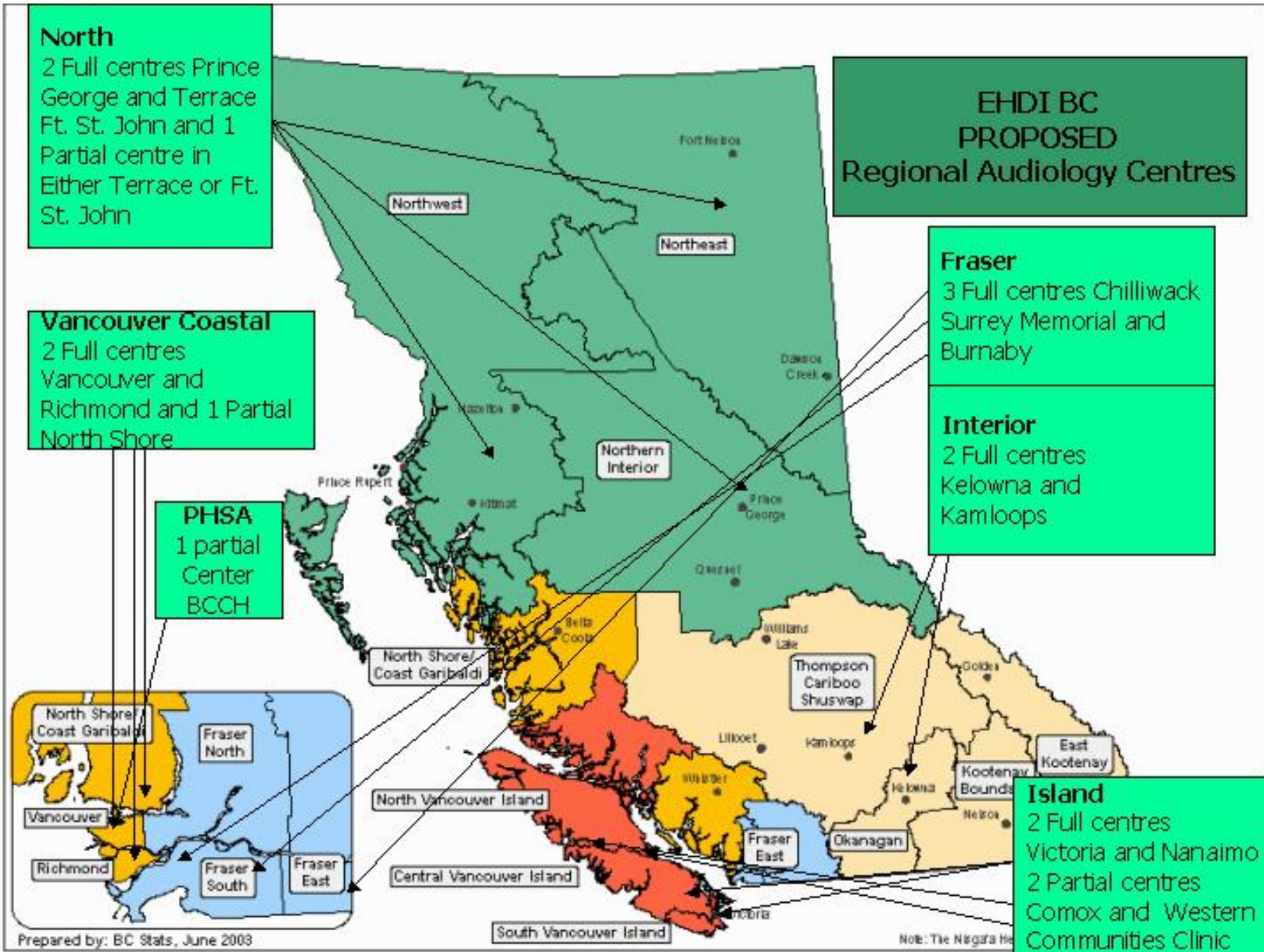
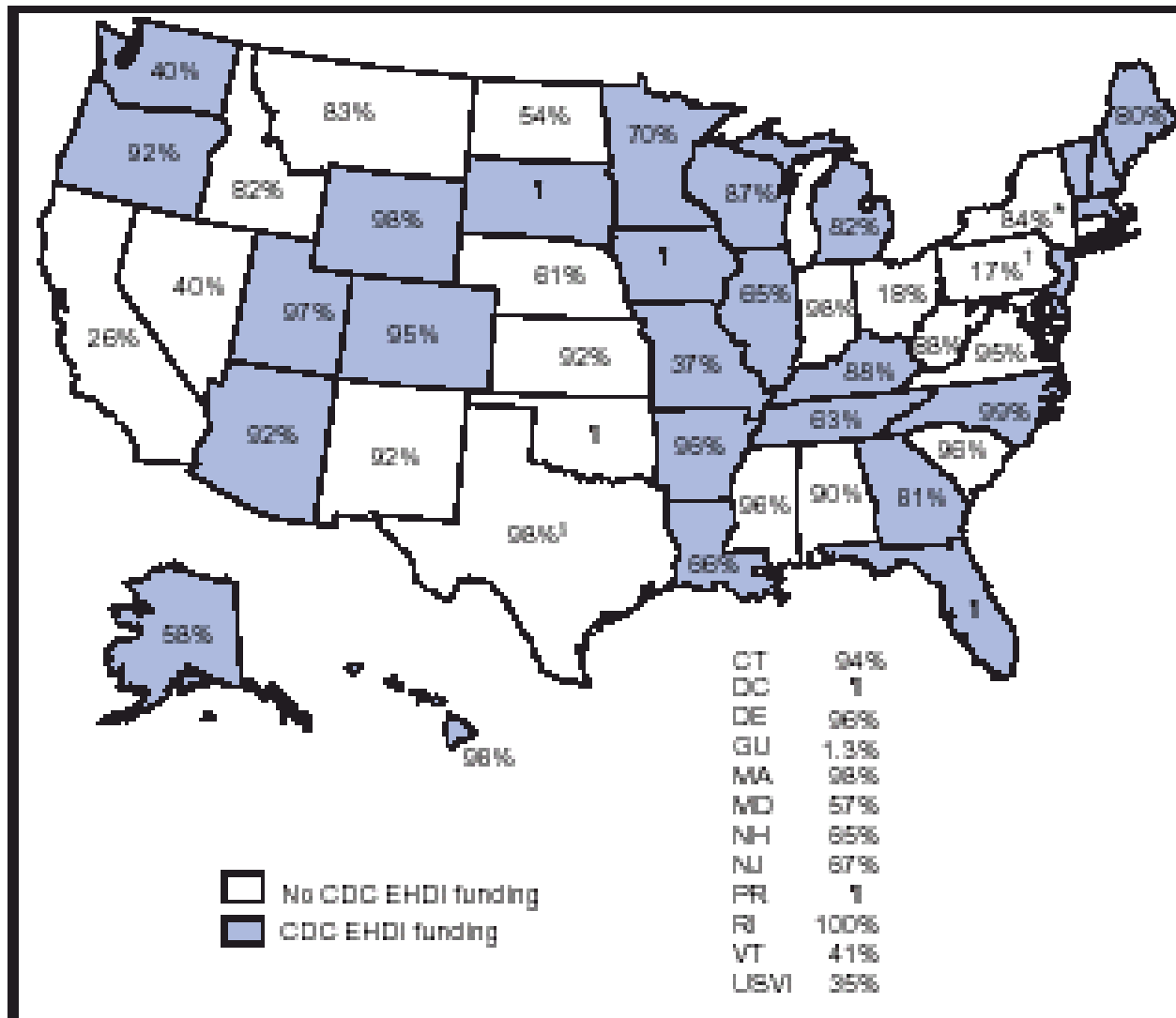


FIGURE. Percentage of newborns screened for hearing loss through Early Hearing Detection and Intervention (EHDI) programs, by state/area and funding status — United States, 2001



* Data reported only for October 20–December 31.

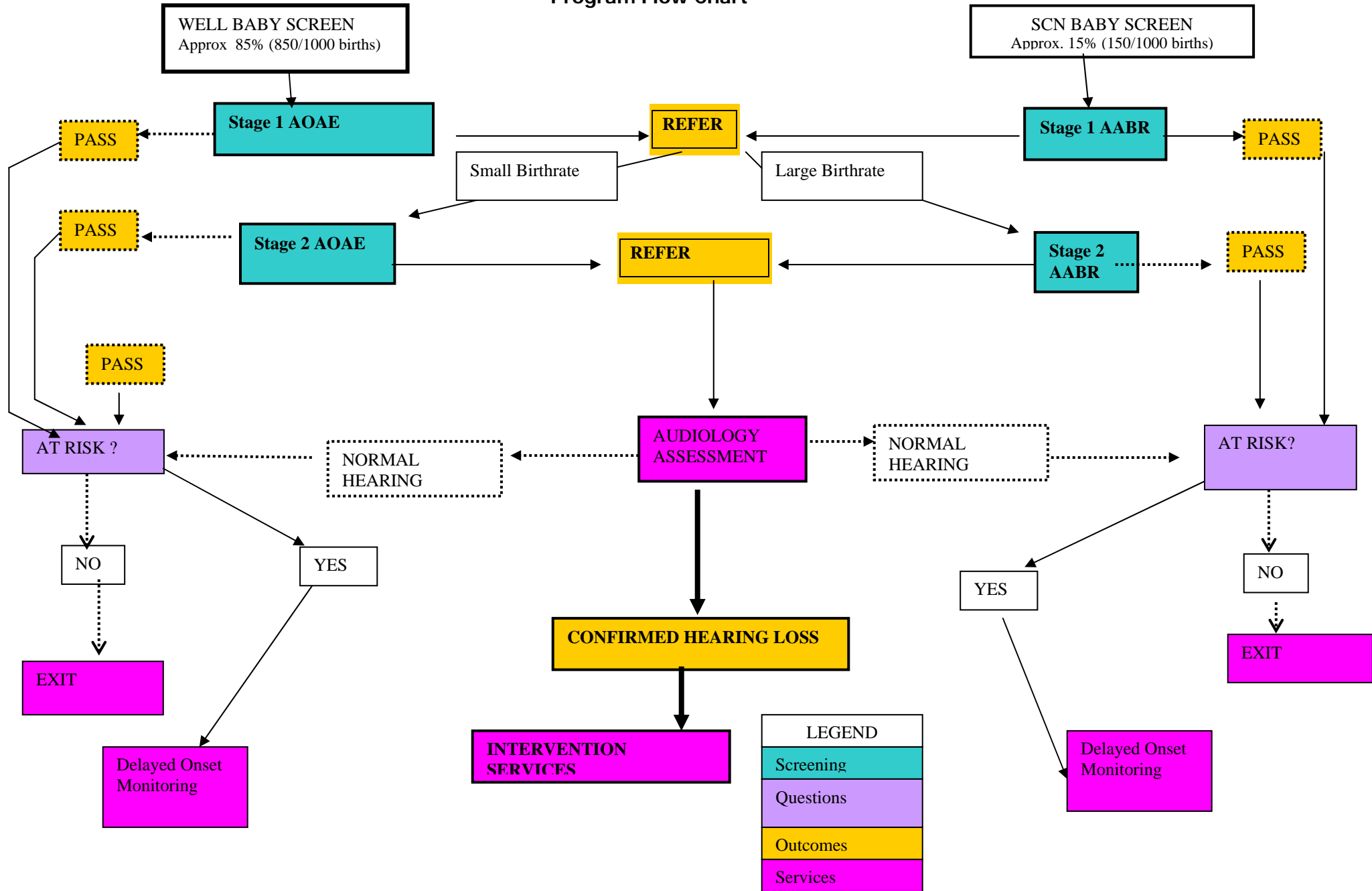
† Data reported only from a pilot project of 26 hospitals.

§ Data reported only for June–December.

¶ Screening rate unknown.

Appendix K

Program Flow Chart



GLOSSARY

AABR – Automated Auditory Brainstem Response

ABR – Auditory Brainstem Response

Acoustic Immittance Audiometry - objective audiology test that measures the status of the auditory system, specifically the middle ear system and an important auditory reflex

Acquired hearing loss – hearing loss due to external factors occurring after birth, e.g. meningitis, trauma, ototoxic medication

Air conduction – testing using air conduction transducers; air conduction testing sends the auditory stimulus to the Inner through the Outer Ear and the Middle Ear

American Sign Language (ASL) - a manual language with its own word order and grammar, used primarily by people who are Deaf

Amplification – use of hearing devices to increase audibility of sound, enabling child to use residual hearing for communication

AOAE – Automated Otoacoustic Emissions

ASL - American Sign Language

Assistive listening device (ALD) – products used to augment hearing or to assist the hearing aid in difficult listening situations

Atresia -a type of birth defect causing a complete closure of the ear canal

Audiometer – equipment used for measuring hearing acuity.

Audiometry – measurement of hearing acuity

Auditory Brainstem Response (ABR) test - a test that can be used to assess auditory function in infants and young children using electrodes on the head to record electrical activity from the hearing nerve. Frequency specific tone pip ABR provides threshold information required for diagnosis of hearing loss and selection of amplification. Click ABR is used to evaluate neurological functioning to identify conditions such as auditory neuropathy.

Auditory Cortex- the portion of the Cerebral Cortex that processes auditory information

Auditory Dys-Synchrony - recently recognised disorder of hearing that is thought to originate in the cochlear inner hair cells or the cochlear nerve, causing variable responsiveness to sounds, poor discrimination abilities and reduced benefit from amplification. There is a higher incidence in graduates of Special Care Nursery or with neurological risk factors.

Auditory Nerve – the nerve that conveys neurological information from the Inner Ear structures to the central nervous system. Also known as the VIII Cranial Nerve. The Auditory Nerve is one portion of the sensorineural mechanism; the other portion is the cochlea.

Auditory Training - listening to environmental sounds, music and speech to practice recognizing and understanding what has been heard

Auditory-Verbal Therapy - an intervention model emphasizing use of amplified residual hearing or cochlear implant to listen, to process verbal language, and to speak

Aural (re)habilitation -specialized training for people with hearing loss to help them learn spoken communication skills through speech reading and auditory training

Automated Auditory Brainstem Response (AABR) –ABR screening test, which automatically judges “pass” or “refer,” based on pre-set protocols, screening for greater than 35 dB hearing loss

Automated Otoacoustic Emissions (AOAE) –OAE screening test, which automatically judges “pass” or “refer,” based on pre-set protocols.

Behavioural Observation Audiometry (BOA) – test protocol where an auditory stimulus is presented to the client and the unconditioned behavioural response is observed and recorded.

Behavioural assessment – testing which requires an age-appropriate response from subject, includes BOA, VRA, play audiometry

Behind-the-ear hearing aid – a hearing aid that fits behind the pinna, and is attached to an earmold; abbreviation is BTE

Bilateral – both ears

Bone conduction hearing aid – a hearing aid that sends sound energy to the Inner Ear through skull vibration, bypassing the Outer and Middle Ears; generally used for conductive hearing loss

Bone conduction –testing using the bone conduction transducer; bone conduction testing bypasses the Outer Ear and Middle Ear, and sends the auditory stimulus directly to the Inner Ear using vibration of the skull bones

Bone-anchored hearing aid – type of hearing aid, which is surgically implanted in the bone behind the ear

BTE – abbreviation for Behind-the-ear hearing aid

Case Manager – for the purposes of this document, the primary contact for families of infants diagnosed with hearing loss. The role of the Case Manager is to assist families in navigating through assessment and intervention services, coordinating referrals, providing unbiased information on options for services, and counselling and support. This may be an Audiologist, Speech-Language Pathologist, Teacher of the Deaf and Hard of Hearing, Infant Development Worker, Infant Development Consultant, Family Support Worker or other professional.

Central Auditory Pathways – the neural pathways that start at the VIIIth Cranial Nerve (Auditory Nerve) and travel to the Auditory Cortex

Central Auditory Processing Disorder-a disorder of the Central Auditory Pathways or Auditory Cortex

CI – cochlear implant

Cochlea - also called the "inner ear." A snail-shaped structure that contains the sensory organ of hearing and changes sound vibrations to nerve impulses. The impulses are carried to the brain along the VIII nerve, or auditory nerve.

Cochlear Implant (CI)- a medical device that is surgically implanted and bypasses damaged inner ear structures and directly stimulates the auditory nerve, helping individuals who have severe to profound hearing loss to interpret sounds and speech

Conditioned Play Audiometry – test protocol where an auditory stimulus is presented to the client and the conditioned behavioural response (i.e., play response) is observed, rewarded and recorded; typically used with children from age 30 months to 5 years

Conductive hearing loss – hearing loss resulting from pathology in the Outer or Middle Ear; characterized by the presence of an air/bone gap

Deaf (with capital D) -- a term used to refer to those who consider themselves part of the Deaf community or culture and choose to communicate using American Sign Language instead of spoken communication

deaf - a term usually used to describe persons who have a profound hearing loss greater than 90 dB HL

Delayed-onset hearing loss – childhood hearing loss not present at birth

Delayed onset risk factors – a set of risk factors, such as family history and low birthweight, which may indicate risk for delayed onset of hearing loss

Diagnostic Audiology – audiology assessment using age appropriate tests and techniques to diagnose type and degree of hearing loss

Direct audio input – direct transmission of a sound signal into a hearing aid

Directional microphone – microphone that picks up a signal only from one direction

Distortion Product Otoacoustic Emissions (DPOAE) - a type of Otoacoustic emissions test

DPOAE – Distortion Product Otoacoustic Emissions

Early Hearing Detection and Intervention (EHDI) – comprehensive program of universal infant screening, diagnostic follow up and enrolment in early intervention programs

Early Identification – confirmed diagnosis of permanent congenital hearing loss by 6 months of age

Earmold -- A mold that anchors the hearing aid to the ear and channels sound to the ear canal

EHDI – Early Hearing Detection and Intervention

EHDI-BC – BC cross-disciplinary group steering the development of provincial EHDI initiative for BC

Electro-physiological – objective diagnostic tests which do not require a behavioural response but use physiological responses, such as ABR, OAE, or tympanometry

Feedback (acoustic) – a high-pitched squeal produced by a hearing aid and caused most often by a poorly fitted earmold. Feedback can also be caused by cracked earmold tubing, earwax in the earmold, or a crack in the ear hook or hearing aid case.

FHA – Fraser Health Authority

FM System - A radio system that delivers frequency modulated signals to either a group receiver or individual receiver units; often used in conjunction with a hearing aid to improve ability to hear selected voice in noisy environments

Habilitation – intervention for speech and language, provided to individuals who lose hearing before speech has developed

Habilitative Audiology – prescription and evaluation of amplification, including ongoing monitoring of hearing, amplification, and service provision by an Audiologist

Hard of Hearing - the term to describe those with mild to severe hearing loss

Hearing Aid -- an electronic device that brings amplified sound to the ear

Hearing Devices – broad term used for any device which improves ability to hear sounds; may include hearing aids, cochlear implants, FM systems and other assistive listening devices

Hearing Loss (or impairment) - a problem with hearing that is characterized by decreased sensitivity to sound in comparison to normal hearing (See conductive, sensorineural, and mixed hearing loss.)

Hereditary Hearing Impairment - hearing loss passed down through generations of a family.

High Priority Hearing Registry (HPHR) – registry completed by public health nurse for all newborn infants in most regions to assess presence of any of 7 factors with known higher risk for hearing loss. Infants with positive risk factor are screened through public health audiology clinics. This registry provides early identification for 50% of infants with hearing loss, but misses 50% of infants with hearing loss who do not have known risk factor.

High Risk Hearing Registry (HRHR) – see also High Priority Hearing Registry

HPHR – High Priority Hearing Registry

HRHR – High Risk Hearing Registry

IHA – Interior Health Authority

Inner Ear – see cochlea

Intervention – term used to refer to non-audiological services and communication development, such as speech-language therapy, auditory verbal therapy, sign language, counselling and family support

Middle Ear - the part of the ear that includes the eardrum and three tiny bones (ossicles) of the middle ear, ending at the round window that leads to the inner ear

Mixed Hearing Loss - a hearing loss with both conductive (middle ear pathology) and sensory (cochlear or VIIIth nerve pathology) components

Moderate Degree of Hearing Loss - For purposes of screening programs, moderate degree of hearing loss is defined as a hearing threshold of greater than 35 dB HL in the better hearing ear, averaged over 500, 1000, 2000 and 4000 Hz.

Multi-memory hearing aids – hearing aids with different settings or memories for different listening environments

NHA – Northern Health Authority

Objective Audiometry Tests – tests that can estimate auditory sensitivity or auditory system function by measuring a direct electrophysiological response from the auditory systems without the need for a behavioural response from the client

Otitis Media – infection of the middle ear

Otoacoustic Emissions (OAE) - low-intensity sounds produced by the inner ear that can be measured with a sensitive microphone placed in the ear canal; a test for function of the outer hair cells in the Inner Ear. Absent response if there is greater than 35 dB peripheral hearing loss, but does not provide threshold information or identify auditory dys-synchrony.

Otolaryngologist - a physician/surgeon who specializes in diseases of the ear, nose, throat, head and neck

Ototoxic drugs – drugs, such as the -mycin antibiotics, that destroy hair cells in the Inner Ear

Outer Ear - the external portion of the ear that collects sound waves and directs them into the ear; consists of the pinna and the ear canal

PCHL – Permanent Congenital Hearing Loss

Peripheral Auditory System - Outer Ear, Middle Ear and Inner Ear

Permanent Congenital Hearing Loss (PCHL) – sensorineural, mixed or structural conductive hearing loss present at or soon after birth; does not include conductive hearing loss due to transient conditions such as middle ear or outer ear fluid

PHIS – Public Health Information System

PHSA – Provincial Health Services Authority

Play Audiometry – pediatric hearing test technique in which the child is trained to perform a task in response to sounds; most appropriate for children age 30 months to 5 years

Postlingually Deafened - an individual who becomes deaf after having acquired language

Prelingually Deafened - an individual who is either born deaf or who lost his or her hearing early in childhood, before acquiring language

Programmable hearing aid – a hearing aid where the amplification characteristics can be fine-tuned using a computer with an interface

Progressive Hearing Loss – hearing loss that becomes worse over time, certain hereditary hearing losses or medical conditions may be associated with deteriorating hearing

Public Health Information System – (PHIS, current Internet version iPHIS) computerized health database used by Public Health Nursing for infant/child assessments, immunizations and communicable disease monitoring; audiology module and infant screening modules available; used in most, but not all, Health Authorities.

Rehabilitative Audiology – audiological services for infants with identified hearing loss; includes ongoing diagnostic evaluation and monitoring of hearing loss, and the selection, evaluation and adjustment of hearing devices if this communication option is selected by family.

SCN – Special Care Nursery or Neonatal Intensive Care Unit.

Sensorineural Loss - a hearing loss caused by damage to the inner ear (cochlea) and/or the hearing nerve.

Serous Otitis – fluid in the middle ear resulting from chronic Eustachian tube dysfunction.

Sign Language - a method of communication used primarily by people who are deaf or hard of hearing in which hand movements, gestures, and facial expressions convey grammatical structure and meaning (See American Sign Language.)

Speech-Language Pathologist - a professional who evaluates and provides treatment for speech, language, cognitive-communication, and swallowing problems of children and adults. (Speech and language delays are frequently seen in children with hearing impairments.)

Stage 1 Screening – initial hearing screening; if “pass,” screening complete; if “refer,” go to Stage 2 Screening.

Stage 2 Screening – follow up hearing screening for infants who “refer” from Stage 1 screening. If pass, screening complete. If “refer” move to diagnostic assessment.

Structural Conductive Hearing Loss –conductive hearing loss caused by abnormal outer or middle ear, such as atresia (absence of ear canal), malformed ossicles (middle ear bones), or absent tympanic membrane (eardrum). These hearing losses are sometimes correctable by surgery after full growth of the head (late teens or adult). These are classified as “permanent” hearing losses, as most cannot be corrected in childhood.

Sudden Deafness - the loss of hearing that occurs quickly due to such causes as an explosion, a viral infection, or the use of some drugs

Syndrome-set of symptoms that together characterize a disease or disorder

Syndromes Hearing Impairment -- a hearing loss that is accompanied by additional physical characteristics (e.g., blindness, mental retardation or involvement of other organs)

TEOAE –Transient Otoacoustic Emissions

Threshold – intensity at which an individual can just barely hear a sound 50% of the time.

Transient Otoacoustic Emissions – a type of otoacoustic emission test

Tympanic Membrane – eardrum, separating the Outer Ear from the Middle Ear

Tympanometry - physiological measure of middle ear function

UNHS- Universal Newborn Hearing Screening

Unilateral Hearing Loss - a hearing loss in one ear only

VCHA – Vancouver Coastal Health Authority

VIHA – South – Southern portion of Vancouver Island Health Authority

VIHA – Vancouver Island Health Authority

VIHA -- North – Northern portion of Vancouver Island Health Authority

Visual Reinforcement Audiometry (VRA) - a pediatric hearing test procedure in which the child's responses to sound are reinforced with a visual event (e.g., a moving toy). This procedure is most appropriate for children in the 6 month to 3-year age range.

VRA – Visual Reinforcement Audiometry

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