

The Clinical Effectiveness of Different New-born Hearing Screening Strategies. A Decision Analysis.

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INTRODUCTION

Children with connate hearing impairment benefit from early detection and treatment of their hearing loss. There is no model that explicitly quantifies the effectiveness of universal newborn hearing screening (UNHS) versus other program alternatives in terms of early diagnosis, nor has it been taken into account that diagnosis of hearing impairment within the first few months of life is more “valuable” for further development than diagnosis later in life.

OBJECTIVES

To systematically compare two screening strategies for the early detection of new-born hearing disorders, UNHS and risk factor screening, with no systematic screening regarding their influence on early diagnosis.

METHODS

Design: Clinical effectiveness analysis. We developed a state-transition (Markov) model with monthly cycles to reflect the course of disease and diagnosis under the three screening strategies (figure 1). Probabilistic modelling was carried out by Monte Carlo simulations.

Data Sources: Systematic literature review, empirical data survey, and expert opinion. We searched 13 medical databases including MEDLINE, EMBASE, Current Contents for published papers and HTA databases for published HTA reviews. We restricted our search to publication date 1990 to September 2001. The probability of detection at a certain age without screening was calculated from a representative survey, covering all diagnosed cases and the age of diagnosis in Upper Bavaria in 1998 and 1999. The slope of the weight function was estimated by experts.

Target Population: All newborn children.

Time scale: 6, 12 and 120 months.

Perspective: Health care system.

Compared Strategies: UNHS, Risk factor screening (RS), no systematic screening (NS).

Outcome Measures: Quality weighted detected child months (QCM). For example, if a hearing impairment was diagnosed briefly after birth, the infant contributed six QCM at the age of six months. If the infant’s hearing loss was diagnosed at the age of five months, the infant added only one detected child month at the age of six months.

RESULTS

UNHS detected 644 QCM up until the age of 6 months (72,2%). RS detected 393 child months (44,1%) and no systematic screening 152 child months (17,0%). UNHS detected 74,3% and 86,7% weighted child months at 12 and 120 months, RS 48,4% and 73,3%, NS 23,7% and 60,6%. At the age of 6 months UNHS identified approximately 75% of all children born with hearing impairment, RS 50% and NS 25%.

At the time of screening UNHS marked 10% of screened healthy children for further testing (false positives), RS 2%. UNHS demonstrated higher effectiveness even under a wide range of relevant parameters.

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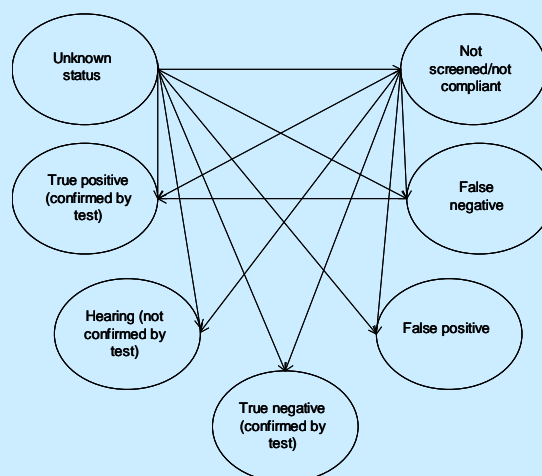


Figure 1: New-born hearing screening states

Sensitivity Analyses: Resulting QCM strongly depended on the prevalence of hearing disorders. Very low prevalence decreased the incremental benefit of UNHS versus RS. Comparing UNHS vs. RS, a prevalence of 9 per 1000 children yielded a gain of 1241 QCM, a prevalence of 15 per 1000 yielded a gain of 2027 QCM. The results were insensitive to varying assumptions about test parameters and the proportion of children lost to follow up. A decrease in slope of the linear weighting function resulted in decreasing incremental QCM. If detected child months were not weighed according to time of diagnosis, UNHS would still be superior to RS and RS to NS in terms of detected child months.

LIMITATIONS

QCM is a surrogate parameter for the actual burden of disease for the child. Preference-based utilities have not been measured and the weighting for the impact of early or late identification of hearing loss is still unknown.

CONCLUSIONS & RECOMMENDATIONS

This model is the first to model a time-dependent and quality-weighted outcome, to introduce empirical data of the natural history of discovery and to present the results within a probabilistic framework. We have shown that UNHS is able to reduce the age at confirmation of hearing loss to a much greater extent as selective RS. Further research should be performed on quality of life and health care utilization due to hearing loss and the proportion of children who follow a regular school and profession career after timely fitting of a hearing aid.

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