

# Analysis of changes in the Polish Universal Neonatal Hearing Screening Program over 15 years

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## ABSTRACT:

**Introduction:** The Polish Universal Neonatal Hearing Screening Program (PUNHSP) is one example of a nationwide pro-health program in Poland. This program is aimed at early diagnosis and intervention in children with hearing impairment, and is an example of a well-managed program. Presenting the results of the PUNHSP, particularly organisational aspects and experience, can assist institutions managing other programs to achieve high efficiency. The aim of this work was to perform a detailed analysis of the PUNHSP by identifying the changes implemented over the 15 years it has been active, as well as the consequences of their introduction in terms of improved quality and efficiency.

**Materials and methods:** Data from the PUNHSP, registered in the central database, were evaluated, as well as organisational information related to management, IT support and infrastructure. The analysis was based on quality assessment parameters (identification of changes and the purpose of their introduction) and effectiveness (consequences of introducing the changes). The analysis includes the 15-year period in which the PUNHSP has been active, from 2002 to 2017.

**Results:** Thirteen main modifications of the program were identified according to the definition of “change”, in addition to 11 smaller modifications resulting from the necessity to adapt to current requirements. The changes were grouped into five categories: legal, administrative, management, audit and control, and IT.

**Discussion:** The changes implemented in the PUNHSP can be assumed to have positively influenced various aspects of the program, but do not exhaust the possibilities for further optimisation of functioning.

**Conclusions:** The program requires constant development in order to increase the efficiency and effectiveness of its operation, and the changes and solutions implemented in this program could be applied to improve existing pro-health programs, as well as those yet to be created.

## KEYWORDS:

hearing loss, newborn hearing screening, pro-health programs

## INTRODUCTION

There are several hundred pro-health programs implemented in Poland at the level of territorial self-governments [1]. Non-governmental health programs are run by public benefit organisations and foundations for which there is no single register, and their exact number is not known. These programs differ in regard to their organisation, universality and data availability. Due to the individual characteristics and uniqueness of each of these programs, there are no tools, systems or algorithms available to enable evaluation and comparison among similar programs. Therefore, it seems necessary to present not only

the results, but also the organisational aspects and experiences, both positive and negative, which could help program managers to achieve the highest efficiency for their own programs.

One example of a nationwide pro-health program in Poland is the Polish Universal Neonatal Hearing Screening Program (PUNHSP). This program is aimed at early diagnosis and intervention in children with hearing impairment [2,3]. It is a universal program covering almost all newborns in Poland, and is highly regarded [4].

The aim of this study was to perform a detailed analysis of the

PUNHSP over the 15 years it has been active, by identifying the changes implemented and the consequences of their introduction in terms of improved quality and efficiency.

## MATERIALS AND METHODS

Data collected during the PUNHSP, as registered in the central database (CDB), was analysed, in addition to organisational information related to management, IT support and infrastructure. Information on the changes implemented in the program was obtained from technical documentation and directly from the Great Orchestra of Christmas Charity Foundation (GOCCF). Currently, more than 5.5 million newborns are registered in PUNHSP, all of whom have undergone hearing screening tests, diagnosis and intervention, across 501 centres that have implemented the program objectives. The structure of the program is presented in Table I.

The changes that have been implemented during the 15-years the PUNHSP has been active were identified and analysed. "Change" was defined as a transition of a feature or thing into another state that may affect every aspect of the organisation (including PUNHSP activities), and may have consequences beyond the area in which it takes place [5]. Based on the information gathered, an assessment was made into the effects of introducing specific changes. The changes were identified and grouped depending on the related area of operation of the program. Evaluation of the program's activity and development took into account all of the modifications that had been introduced. The analysis was based on quality assessment parameters (identification of changes and objectives of their introduction) and effectiveness (consequences of their implementation). The analysis concerned the entire 15-year period of PUNHSP functioning, between 2002 and 2017. Due to the non-parametric nature of the data, a descriptive analysis of the variables was performed.

## RESULTS

As a result of the analysis, 13 main modifications of the program were identified according to the definition of change adopted in this study. A further 11 smaller changes were also identified, resulting from the need to adapt the functionality of PUNHSP to current needs. Three major changes were implemented within the first 2 years of the program, while 10 successive major changes in the functioning of PUNHSP were carried out over the last 10 years. The list of changes was grouped into five categories: legal, administrative, management, audit and control, and IT.

## MAIN CHANGES

### I. Legal changes

*1. Introduction of the obligation to conduct a hearing screening of all newborns (6 months after the start of the program).*

In July 2003, a regulation was issued by the Minister of Health [6] on the scope of health services, in particular, screening tests and the periods over which these tests should be carried out. The purpose of the introduction of this regulation was to cover every newborn child in Poland with compulsory hearing screening. The effect of this change was an increase in the number of newborns covered by hearing screening tests from 97.8% of children entered into the CDB in 2004 to 98.4% in 2017.

*2. The obligation to submit electronic data on an ongoing basis (11 years after the start of PUNHSP).*

The obligation to systematically supplement electronic data within a period no longer than 1 month after the examination was established 11 years after the start of the PUNHSP. The purpose of the introduction of this regulation was to increase the regularity of data entry into the CDB. The effect of the changes was to improve the quality and number of entries in the CDB. Since the introduction of this regulation in 2014, there was an increase in systematically supplemented entries to the CDB from 95.9% in 2014 to 96.6% in the first half of 2017 [7].

### II. Changes in administration

*1. Establishment of a permanent Medical Coordinator Office of the PUNHSP (6 years after the start of the program).*

The purpose of establishing this unit was to facilitate the maintenance of constant contact with the centres participating in the program. The effect of creating the Coordinator's Office was the possibility of direct two-way contact between centres participating in the PUNHSP and the Medical Coordinator Office. This change has enabled the ability to react quickly in case of problems related to the daily functioning of PUNHSP.

*2. Creation of a website for the PUNHSP (8 years after the beginning of the PUNHSP).*

In 2011, a website was created devoted to hearing screening in newborns. The purpose of its creation was to improve the availability of information regarding hearing screening. The outcome of this was that all important news about the program and information for parents were gathered in one location.

### III. Changes in management

#### 1. Individualisation of material orders (1 year after the PUNHSP began).

In 2004, the rules for sending forms, certificates and leaflets were changed. The aim of this change was to standardise way of processing orders in individual centres. The effect of introducing this change was a reduction in the gaps or surpluses of materials necessary for the smooth functioning of PUNHSP, thus reducing the cost of running the program.

#### 2. Partial limitation of the amount of paper documentation (8 years after the start of the program).

The purpose of this change was to reduce the paper copies of the hearing screening results for each newborn from four to two copies. The effect of the introduced change was a 50% reduction in printed materials and the elimination of archive maintenance costs, which amounted to PLN 21,000 annually (data from the founder, GOCCF). Only cards intended for the medical documentation of individual PUNHSP centres and a copy for the parent(s) remained in circulation.

### IV. Audit and control

#### 1. Creation of a coherent system for commenting on incidents (12 years after the PUNHSP was launched).

The purpose of the introduction of the new system was to enable monitoring of matters related to the daily coordination of the PUNHSP, reporting of results and maintaining active contact with all participating centres. The effect of the introduced change was improved functioning of the Medical Coordinator's Office, enabling quicker responses to existing problems, improved contact with the IT department, the GOCCF and the medical department, as well as increased effectiveness of the entire PUNHSP team. Each person supervising the PUNHSP could easily and quickly trace the situation in the selected centre. The comment database functions to gather information about all problems reported by the centre, issues with entering data into the CDB, failure of equipment required to perform hearing screening tests and IT problems.

#### 2. Change in the reporting system (7 years from the beginning of the PUNHSP).

In 2010, a new version of the reporting module was created. The purpose of this modification was to standardise data collected in the CDB. The effect of the introduced change was allowing quick and easy access to the data most often analysed in the daily activities of the Medical Coordinator Office.

**Tab. I.** Structure of the Polish Universal Neonatal Hearing Screening Program (PUNHSP).

PUNHSP LEVELS	SUPERVISION	IT BACKGROUND	FINANCING
Level I, early detection of hearing impairment Neonatology department.	Medical coordinator of the program.	An external company in the IT industry. Management of database infrastructure, security policy and protection of personal data.	Medical procedures. National Health System.
Level II, diagnosis of hearing loss ENT and audiological centres	Coordinator for reports and analyses of the program.	Responsible for equipping centres with computer equipment, storing data flowing from centres, running hotlines with technical assistance for centres and IT support.	Hearing test equipment, data transmission equipment for CDB, training of personnel, printed forms and certificates. GOCC Foundation
Level III, intervention ENT and audiological centres	Logistics coordinator of the program.		

#### 3. Modification of hearing screening certificates (9 years after the start of the program).

The purpose of this change was to emphasise the need for diagnostic tests in children with suspected hearing loss and further observation of the child. The effect was to increase the awareness of parents of children requiring further diagnosis, and to increase number of parents making an appointment to the follow-up visit in level II of PUNHSP. Before the introduction of this change in 2009, 41.4% of visits of children requiring further diagnosis were registered in the CBD, which reached 52.3% in 2016 after the introduction of this change. After taking into account the data from the surveys carried out among parents of children who were not registered as having made the final visit, the percentage was 83% [8].

#### 4. Introduction of control of test results at higher levels of PUNHSP (12 years after the PUNHSP started).

The aim of this change was to increase the effectiveness and efficiency of PUNHSP activities at the second level, covering all children requiring a control visit according to the requirements of the program. The result was the identification of irregularities in entries to the CDB, which overstated the number of children requiring further diagnosis (Table I).

#### 5. Verification of PUNHSP data obtained with external data (12 years from the beginning of the PUNHSP).

The control of data collected in the CDB was introduced on the

basis of information from two external sources, the Central Statistical Office (CSO) and the National Health Fund (NHF). The purpose of introducing controls based on the CSO and NHF sources was the ability to obtain the exact number of live births for a given year as well as information on the number of births in individual centres relevant for the first level of the program. The effect of such a control system was the possibility of comparing the number of deliveries in each centre participating in PUNHSP, which resulted in an increase in the number of children registered in the CBD from 94.3% in 2009 to 96.6% in 2017.

## V. IT Changes

### 1. Changes in the software (1 year after the start of the program).

One year after the start of the program, a number of changes were made to the electronic data entry software, including the possibility of fixing incorrectly entered dates, entering and sending data without needing to enter the general ledger number and the child's sex, as well as the hearing screening test result. Particular attention was paid to the introduction of the first and last name of the person conducting research in the database. The purpose of introducing this change was to obtain high-quality data in the CBD. The effect of the introduced changes was a database with no duplicate information, thereby improving its reliability.

### 2. Changing the method of data transfer (6 years after the PUNHSP began).

In 2009, there was a change in the method of data transfer involving changing the packet data transmission protocol (GPRS) to a network protocol. Terminals for entering the PUNHSP data were exchanged. The purpose of the introduced change was to improve the IT infrastructure. The effect was improvement in the regularity of the entered data and faster data transfer.

## SIDE CHANGES

Eleven other program modifications were identified during the analysis. These were changes resulting from the need to adapt the PUNHSP functionality to the current needs of the program. They included elimination of the need to enter the name of the primary care physician, introduction of three types of visits at the PUNHSP diagnostic level in the CBD (Table 1), increase in the number of reports generated based on the CBD, obligation to enter the reason for not reporting on the diagnostic level, change in data processing software, date selection from an interactive calendar, generating reports on

the status of CBD entries for individual centres, modification of the screening card, removal of duplicates from the CBD, introduction of a new interface in the data entry module and introduction of permanent contact with centres.

## DISCUSSION

Nationwide, universal pro-health programs represent a huge logistical, organisational and financial challenge. This is evident across Europe, when comparing analogous hearing screening programs in England, Germany and Italy [9-13]. Most programs run by government units are either central (e.g., in England [10]) or regional (e.g. in Germany, Italy and France [9, 11-14]). Poland is one of two countries in Europe, along with Cyprus, that has an organised hearing screening program which is supported and coordinated by a non-governmental organisation [9].

The PUNHSP data is collected in a central way, and the generation of analyses and summaries is possible on an ongoing basis using a specially designed reporting module. The situation is similar to that implemented in the UK, where national IT system data can be explored using searches and exports, and statistical data analyses are performed to improve system performance [15]. It is different in Wallonia and Brussels (Belgium), where data on audiological intervention under the screening program (i.e., test results) are not collected at all [16].

Close cooperation with an IT company made it possible to efficiently collect and process data to create a homogeneous collection. The comment system developed as part of the PUNHSP (change IV.1), made it possible to quickly respond to existing problems, which significantly limited the duplication of tasks. Thanks to this change, the activity of individual centres is visible (positive and negative). This allows for quick problem-solving or support for well-managed centres. In addition, as the database is sealed (change I.2), it is not possible to complete a full record in the database without providing details about the depth and type of hearing impairment.

The analysis showed that the proper functioning of the program also depends on constant monitoring of the activities of all centres. It is therefore important to control the quality and quantity of entries into the database. Good, reliable data facilitates the planning and preparation of long-term activities related to improving the life of newborns with hearing impairment. Similarly, this has been implemented in the UK, where the screening program is a part of the National Health Service, and information about newborns and their full medical history is collected automatically [10].

According to data from the CBD, before the establishment of the Medical Coordinator Office in 2009, the reporting for further audiological diagnostics was only 47.5% [2], and represented the weakest element of the PUNHSP. This problem was also raised in the US, where it was pointed out that it is necessary to have a system of monitoring and supervision of children with suspected hearing loss in each state, as well as integration with the health care system [17-18]. The modifications introduced by the Medical Coordinator Office (change IV.4) allowed this data to be obtained at estimated level of 83% [9]. The launch of the pilot program assisted in achieving such a result, which contributed to the improvement in parents' knowledge regarding the need to perform diagnostic tests to detect hearing loss and to gather information on the reasons for not reporting for a diagnostic visit [8]. Similar results have been reported in Switzerland, Italy and in some US states [19-22].

Finance is an important aspect of the operation of each pro-

gram. In the case of the PUNHSP, the GOCC Foundation bears the average cost of 1.6 million PLN per year, which accounts for the printed materials, certificates, space rental and IT services [23]. The move from printing the documentation to digitalisation and sealing of the data collection system has helped to reduce the fixed costs (e.g., archiving).

## CONCLUSIONS

Multilevel cooperation of people involved in the operation of PUNHSP allows for its continuous development in order to achieve the best possible results. By analysing the PUNHSP and the changes introduced over the years, it is clear that these changes have had a positive influence on the individual areas that have undergone modifications. However, there is a need to look for new solutions in order to further increase the efficiency and effectiveness of the program, and these solutions could be applied to other pro-health programs.

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