Summary Vision Screening Data: Hungary

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1 Glossary of Terms: Vision Screening

Abnormal test result	A test result where a normal "pass" response could not be detected under good conditions. The result on screening equipment may indicate "no response," "fail," or "refer."
Attendance rate	The proportion of all those invited for screening that are tested and receive a result: • Invited for screening includes all those that are offered the screening test. • Tested and receive a result could be a "pass" or "referral to diagnostic assessment". Attendance rate provides information on the willingness of families to participate in screening.
Compliance with referral (percentage)	The percentage of those who are referred from screening to a diagnostic assessment that actually attend the diagnostic assessment. Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.
Coverage	The proportion of those eligible for screening that are tested and receive a result: • Eligible for screening includes those within the population that are covered under the screening or health care programme. • Tested and receive a result could be a "pass" or "refer to diagnostic assessment". Factors such as being offered screening, willingness to participate, missed screening, ability to complete the screen, and ability to document the screening results will influence the coverage.
False negatives	The percentage of children with a visual deficit (defined by the target condition) that receive a result of "pass" during screening. Example: If 100 children with visual deficit are screened, and 1 child passes the screening, the percentage of false negatives is 1%.

False positives	The percentage of children with normal vision that are referred from screening to a diagnostic assessment.
Guidelines	Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.
Vision screening professional	A person qualified to perform vision screening, according to the practice in the country or region.
Inconclusive test result	A test result where a normal "pass" response could not be detected due to poor test conditions or poor cooperation of the child.
Invited for screening	Infants/children and their families who are offered screening.
Outcome of vision screening	An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of children detected, etc.
Untreated amblyopia	Those children who have not received treatment for amblyopia due to missed screening or missed follow-up appointment.
Persistent amblyopia	Amblyopia that is missed by screening, or present after the child has received treatment.
Positive predictive value	The percentage of children referred from screening who have a confirmed vision loss. For example, if 100 babies are referred from screening for diagnostic assessment and 10 have normal vision and 90 have a confirmed visual defect, the positive predictive value would be 90%.
Prevalence	The percentage or number of individuals with a specific disease or condition. Prevalence can either be expressed as a percentage or as a number out of 1000 individuals within the same demographic.
Programme	An organised system for screening, which could be based nationally, regionally or locally.
Protocol	Documented procedure or sequence for screening, which could include which tests are performed, when tests are performed, procedures for passing and referring, and so forth.
Quality assurance	A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.
Referral criteria	A pre-determined cut-off boundary for when a child should be re-tested or seen for a diagnostic assessment.

Risk babies / Babies at-risk	All infants that are considered to be at-risk or have risk-factors for vision defects/ophthalmic pathology according to the screening programme. Two common risk factors are admission to the neonatal-intensive care unit (NICU) or born prematurely. However, other risk factors for visual defects may also be indicated in the screening programme.
Sensitivity	The percentage of children with visual defects that are identified via the screening programme. For example, if 100 babies with visual defects are tested, and 98 of these babies are referred for diagnostic assessment and 2 pass the screening, the sensitivity is 98%.
Specificity	The percentage of children with normal vision that pass the screening. For example, if 100 babies with normal vision are tested, and 10 of these babies are referred for diagnostic assessment and 90 pass the screening, the specificity is 90%.
Target condition	The visual defect you are aiming to detect via the screening programme.
Well, healthy babies	Infants who are *not* admitted into the NICU or born prematurely (born after a gestation period of less than 37 weeks).

2 Abbreviations

ACT: Alternating Cover Test

AR: Autorefraction

AS: Automated Screening

CT: Cover Test

CV: Colour Vision

EI: Eye Inspection

EM: Eye Motility

Fix: Fixation

GDP: Gross Domestic Product

Hir: Hirschberg

HSPOS: Hungarian Society of Paediatric Ophthalmology and Strabismology

NICU: Neonatal-intensive care unit

PPP: Purchasing Power Parity

PR: Pupillary Reflexes

RE: Retinal Examination

RR: Red Reflex Testing

SV: Stereopsis

VA: Visual Acuity

WHO: Word Health Organisation

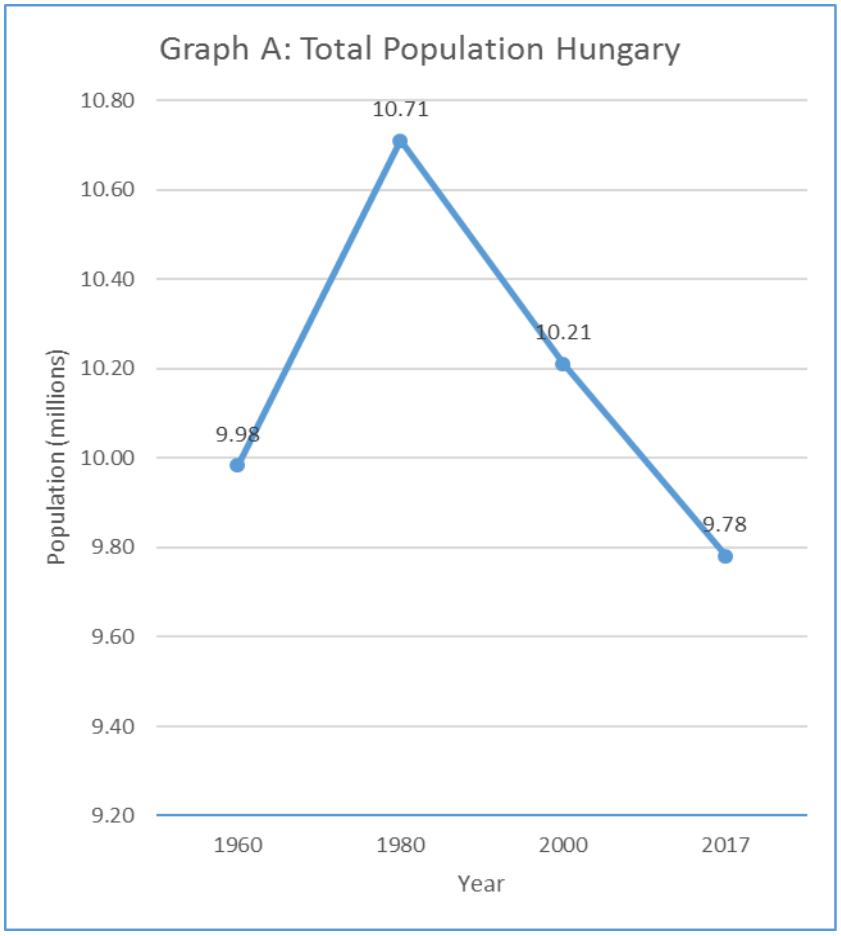
1 Population and Healthcare Overview

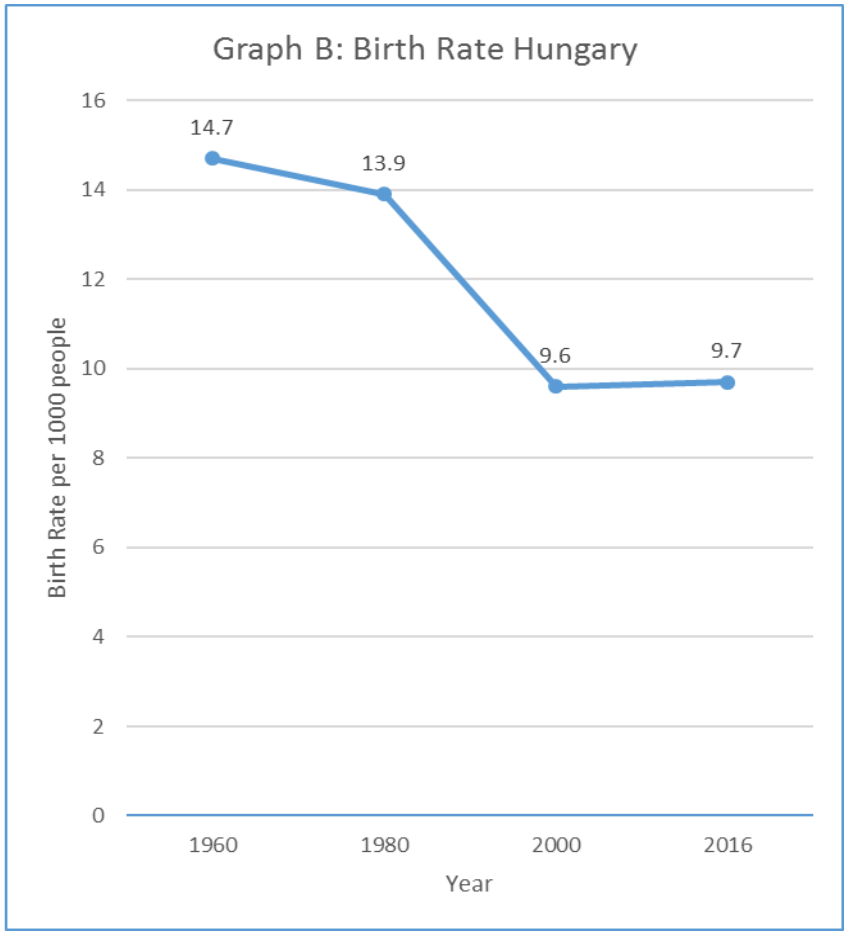
The population of Hungary is 9,781,127 (World Bank, 2018a) and birth rate is estimated at 9.7 births/1,000 population in 2016 (World Bank, 2018b). The change in population and birth rate from 1960 to 2017 is shown in Figure 1, graphs A and B respectively.

Hungary has an estimated population density of 108 people per square kilometre in 2017 and this has fallen from 11 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 1.02 per 100,000 population (WHO, 2016a). Infant mortality in 2017 is estimated at 3.8 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Hungary is estimated at 76 years (World Bank, 2018e), with a death rate of 13 deaths/1,000 population in 2016 (World Bank, 2018f). Hungary has a gross national income per capita (PPP int. $, 2013) of $21,000 (WHO, 2016b). The estimated total expenditure on health per capita in 2015 was $1,428 (Intl $) and the total expenditure on health in 2016 as percentage of GDP was 5.2% (OECD, 2019).

Figure 1: Change in the Total Population and Birth Rate in Hungary between 1960 and 2017





Source: Information sourced from World Bank (2018)

4 Vision Screening Commissioning and Guidance

In Hungary, the vision screening programme is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by the Ministry of Health and the Hungarian Society of Paediatric Ophthalmology and Strabismology (HSPOS). The programme was implemented, nationally, in 1996 and changed in 2006, however the differences are not described. There are no regional variations between protocols, however, there is no central source of money that is allocated equally and it is not stated which tool is best for screening. Therefore, the quality of the purchased equipment for the visual screening depends on the financial situation of the given area. There are various optotypes used before the age of 4-years, and assessment of presence of refractive error is not available for health visitors or pre-screeners. Pre-screeners and opticians (trained or unqualified individuals) can perform basic visual acuity examination, colour vision test, stereotest, autorefraction in an ophthalmological office or optometry practice. There has been a short educational film for health visitors on how to perform the vision screening; however, it has been noted to contain some testing methods that do not adhere to best practice. For example, during visual acuity testing the film advocates covering one eye with a hand; it is acknowledged that a child is able to "peek" using this technique.

Retinoscopy is available only for some ophthalmologists, and not performed by paediatricians or health visitors. The ophthalmologists are equipped with traditional handheld retinoscopes. There are autorefractors in many places, but there are no handheld autorefractors in every ophthalmological healthcare institutes (offices/clinics/hospitals).

Screening is conducted in hospitals, child healthcare centres, private clinics, at the child's home, or at school. It is unknown how many vision screening professionals there are in Hungary. There are general professionals that do not screen but could do so with additional training; these include opticians, nurses and orthoptists. There is currently no specific training provided in order to perform vision screening.

Vision screening is funded through national health insurance, and there are companies that provide vision screening for the children of their employees.

The Ministry of Health, Ophthalmological specialty board, HSPOS, Hungarian Society of Paediatricians and the Hungarian Society of Health Visitors all contribute to the revisions which occur every 10 years. There are no methods imposed by the government for quality monitoring of vision screening and there has been no research concerning the vision screening programme, both from a clinical and cost-effectiveness perspective.

There is no central source of money allocated for vision screening, and there is no protocol concerning which tool is most cost-effective for screening; therefore, the quality of the purchased equipment for the visual screening depends on the financial situation of the area.

5 Screening programme

The target include first-degree family history of congenital cataract and/or glaucoma, retinoblastoma or metabolic disorder associated with ophthalmic diseases, genetic disorders, reduced visual acuity and strabismus. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child as shown in Tables 1, 2 and 3 respectively. Specific details of the screening offered within each age group are described more fully in sections 5.1 to 5.4 below.

5.1 Vision screening - Preterm babies

Preterm babies aged up to the 3 months are screened using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination and pupillary reflexes. These tests are conducted in perinatal intensive care units or in an ophthalmological clinic in a hospital by a paediatric ophthalmologist. Preterm babies are defined as those that are born prior to 32 weeks or weighing less than 1500 grams. Every baby in the perinatal intensive care unit will undergo retinopathy of prematurity (ROP) screening at different time point, dependent upon the gestational week of birth, see Table 4. If the child does not cooperate, screening is repeated once more. The age at which ROP (fundus examination) is conducted for the first time is determined by birth in terms of gestational age (in weeks):

- 22 weeks GA: First fundus examination at 8 weeks
- 23 weeks GA: First fundus examination at 7 weeks
- 24 weeks GA: First fundus examination at 6 weeks
- 25 weeks GA: First fundus examination at 5 weeks
- 26 weeks GA: First fundus examination at 4 weeks
- 27 weeks GA: First fundus examination at 4 weeks
- 28 weeks GA: First fundus examination at 4 weeks
- 29 weeks GA: First fundus examination at 4 weeks
- 30 weeks GA: First fundus examination at 4 weeks
- 31 weeks GA: First fundus examination at 4 weeks

5.2 Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened using eye inspection, fixation, red reflex testing, Hirschberg test and pupillary reflexes. At this age, vision screening is conducted by a health visitor in either hospitals, child healthcare centres, at the parent's home, a private clinic or at university clinics. Babies are referred after any abnormal test result, or after two inconclusive test results.

5.3 Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis and colour vision. Vision screening is conducted by health visitors in hospitals, or at the home of the family. Parents have the option to take the child directly to a university clinic, ophthalmological clinic or private office. Under such circumstances, the vision screening is conducted by an ophthalmologist, where in most cases the child undergoes complete paediatric ophthalmic examination. In this setting, the automated screening devices, for example autorefractometers (Retinomax) and hand held automated vision screening devices (mainly PlusOptix) are used. The complete ophthalmological examination is the following: retinal examination (including indirect ophthalmoscopy, slit lamp examination, refractive measurement by retinoscopy, autorefractors or automated vision screening devices.

At ages 3 to 6 months, red reflex testing, cover test, cover-uncover test and eye motility are performed by either an ophthalmologist or health visitor. The ophthalmologist will also perform intraocular structure assessments and a fundus examination. At 2.5 to 3 years of age, visual acuity (VA) is measured for the first time using various optotype charts (Hungarian LogMAR optotype: the cards correspond to only four levels of visual values (both near and at 5 meters: 0.1; 0.3; 0.6 and 1.0 logMAR). Stereopsis (Lang I, II or Randot tests) is assessed at this age. Children are referred after any abnormal test result, or if there are two inconclusive tests due to poor cooperation, and referred if VA is not 1.0 decimal (0.00 logMAR, 6/6 Snellen). For VA testing of school-aged children health visitors use mainly the Hungarian 'Kettesy chart' with numbers and Ammon's sign, from 5 meters. This optotype resembles the linear random E test.

5.4 Vision screening - 36 months to 7 years

Children aged between 36 months and 7 years are screened by the same method, venue and examiners as between 3 and 36 months of age. The only difference is that VA is measured from ages 4-5 years using Ammon-sign or numbers. Children are referred after any abnormal test result, or if there are two inconclusive tests due to poor cooperation. Before the age of 4 years, the referral criteria regarding visual acuity is<1.0 decimal (0.00 logMAR, 6/6 Snellen). After age of 4 years, the child will be referred to a complete ophthalmological examination if visual acuity with Ammon sign or Landolt C tests is less than 0.7 decimal (0.15 logMAR 6/8.5 Snellen).

Table 1: Healthcare professionals who conduct vision screening in each age group

Table 1	**Paediatric Ophthalmologist**	**Health Visitor**	**Ophthalmologist**
Preterm babies	✓	×	×
0 to 3 months	×	✓	✓ Optional
3 to 36 months	×	✓	✓ Optional
3 to 7 years	×	✓	✓ Optional

Table 2: Vision screening tests used in vision screening for each age group

Table 3	**EI**	**Fix**	**RR**	**EM**	**Hir**	**RE**	**PR**	**CT**	**ACT**	**VA**	**SV**	**CV**	**AR**	**AS**
Preterm babies	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	×	✓	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓ Private only	✓ Private only
3 to 7 years	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓ Private only	✓ Private only

Key:

- *EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg; RE: Retinal Examination; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Test; VA: Visual Acuity; SV: Stereopsis; CV: Colour Vision; AR: Autorefraction; AS: Automated Screening*

Table 3: Location of vision screening for each age group

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Table 2	**Perinatal Intensive care unit**	**Child Health Care Centre**	**Hospital**	**University clinic**	**Private clinic**	**Home**	**Ophthalmological clinic**
Preterm babies	✓	×	×	×	×	×	✓
0 to 3 months	×	✓	✓	✓	✓	✓	×
3 to 36 months	×	×	✓	✓ Optional	✓ Optional	✓	✓ Optional
3 to 7 years	×	×	✓	✓ Optional	✓ Optional	✓	✓ Optional

6 Automated Screening

Automated vision screening is achieved using handheld, portable devices designed to detect presence of refractive error in infants from 6 months of age. It provides objective results and is used to detect amblyopic risk factors. This differs from other methods used to screen children for amblyopia which focus on detection of the actual condition and the resulting visual loss.

In Hungary, the PlusOptix and Retinomax Autorefractor are used to perform automated refraction screening in a few outpatient and University locations, but mainly in private offices or clinics. The cost of the PlusOptix device, including monitor, power supply, wireless keyboard and mouse, is $9,985 (8,779 Euros – 13/12/2018). The maintenance costs are not available and neither are the number of years after which it needs replacing.

In Hungary, these tests are conducted as stand-alone tests. There is no nationwide survey or statistics concerning where and how many places are conducting automated screening and the use of this equipment depends on the areas having the tools available. These tests, if available, are used on all ages and doctors decide on referral, based on professional opinion, there are no official guidelines and it depends on the age of the groups and other circumstances (i.e. family history, the presence of strabismus). Failing the visual acuity test is the main referral criteria, therefore, if a child passes that they will not be referred.

7 Provision for Visually Impaired

In Hungary, there are three state institutes, one for blind children (this is located in Budapest and is a boarding school), and two for children with visual impairment (one is located in Budapest, and the other in Debrecen). There is also one foundation institute (Pécs) for blind children that is funded by the church. One hundred and twenty children attend these schools, and there are a maximum of nine children in each class, with an appropriate number of teachers assigned to the classes.

Severely visually impaired children are defined as those with best corrected visual acuity in both eyes of 5/70 (Snellen chart), or one eye 5/50 and 3/50 in the other eye, or one eye 5/40 and the other eye no light perception of anophthalmia, or kinetic perimetry less than 20 degrees on both eyes.

Parents are eligible to receive a nursing fee, which corresponds to an additional family allowance, if the child is permanently ill or severely disabled. In this instance, the family may receive 71.67 Euros per month. Permanently ill or severely disabled children may be provided with a child-care-person, he or she may receive 79.67 Euros per month.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

Information on prevalence is listed below (Mave.hu, 2018), however, the number of children this relates to is not clear – although, it is stated that these are from national surveys:

- Congenital cataract: 0.06% (prevalence)
- Retinopathy of prematurity (ROP):
  - 52% incidence <750 g at birth weight
  - 32% incidence of 750 to 999 g in birth weight
  - 15% incidence of 1000-1250 g in birth weight
- Congenital glaucoma: 0.01% (prevalence)
- Retinoblastoma: 0.005% incidence over 15 years of age
- Squinting: 4% (prevalence)
- Amblyopia: 2-3% (prevalence)
- Refractive errors: 9% prevalence between 5 and 17 years
- Myopia: 13% prevalence between 5 and 17 years
- Hypermetropia: 28% prevalence between 5 and 17 years
- There is no data available on the incidence of observed cases of the four types of amblyopia (strabismic, refractive, combined mechanism and deprivation).

8.2 Coverage

There is no available data on the coverage and attendance of any kind of vision screening before the age of 7 years.

8.3 Screening evaluation

All children are invited for vision screening by either a health visitor, or a paediatric GP. There is no data available concerning the percentage of compliance with referral after an abnormal screening test result. The percentage of false negatives, false positives, the positive predictive value, the sensitivity and specificity of vision screening are not known

8.4 Treatment success

If a child is referred for further diagnostic examination and found to have a visual impairment, ophthalmologists are then only professionals who prescribe glasses for children under the age of 7 years. Other treatment options include patching, penalisation with glasses, atropine and cataract surgery, where appropriate. It is not clear if all eligible children with vision disorders are treated. It is unknown how many patients are treated for congenital cataract, amblyopia and strabismus per year by orthoptists and/or ophthalmologists.

9 Costs of vision screening in children

9.1 Cost of vision screening

The gross salary for vision screening professionals (ophthalmologists) is between 1,088 to 1,643 Euros per month (13,056 to 19,716 Euros per year) and 437 to 1,526 Euros per month (5,244 to 18,312 Euros per year) for health visitors. The salary varies depending on the number of years worked. The salary per hour for health visitors depends on the numbers of patients of the given district. It fluctuates between 4 Euros per hour and 5.8 Euros per hour.

The costs to train general preventative child healthcare screening professionals from leaving secondary education to qualification: the state budget source for education of health visitors is 1,562 Euros per year, per student. The total sum of the four-year education is 6,250 Euros. The flat cost on the faculty of Health Sciences is 7,500 Euros for the four-year education. These are estimates from the president of the Association of the Hungarian Health Visitors; the real/actual costs are not recorded in any health education institutes. The total screening costs per year and the total costs per child per year are not known.

9.2 Cost of treatment for amblyopia

Patients with refractive and strabismic amblyopia are covered by National Health Insurance, although the parents must buy the prescribed glasses and/or patching. Unfortunately, there is no governmental support for the prescribed glasses, and the cost is often an issue for the families. There is governmental support for the prescribed patching. The costs of patching are estimated at 0.33 EUR/ patch /day. There is no other available data concerning the costs of amblyopia treatment. The parents can decide whether to go to a private clinic or to institutes covered by the National Health Insurance. Due to the lack of a prescreening referral system, every patient can enter directly into hospitals or clinics covered by the National Health Insurance, which is a big burden for these institutes.

There is no specific available data in Hungary, but the estimated cost of amblyopia treatment, based on attached pay-off numbers to a child's medical report is as follows:

The one-time full examination of an amblyopic child= 2,791 German points. Using the National Health Insurance determined multiplier, the 2791 points equate to 6078 Hungarian Forint (HUF), which equates to 8.73 Euros. A child with severe amblyopia is seen about 4 times per year, so the annual cost is estimated at 74.92 Euros.

9.3 Cost of Treatment for strabismus

The estimated costs of strabismus surgery, including follow-up are based on an inpatient record detailing 198,000 HUF (609 Euros). The cost of strabismus surgery (with anesthesia) is 311 Euros.

9.4 Cost of treatment for cataract

The costs of cataract surgery is 736 Euros and the anaesthesia is further 172 Euros, however, the cost of follow-up of the deprivation amblyopia is not known.

Vision screening is free of charge to parents and there are no rewards for attendance or penalties for non-attendance.

The glasses are very expensive for a considerable number of families as the level of state financial support for this is very low. In exceptional cases, it is possible to request support for the purchase of very expensive and high strength glasses or contact lenses. Many citizens cannot afford the treatment options. The travel to an ophthalmologist from a small village or small town, where there is no eye specialist, is not funded by the state. There are opticians, volunteer aid organisations who try to help this population in campaigns. Other issues are considered in terms of non-compliance to treatment such as glasses and patches.

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