Summary Vision Screening Data: Cyprus

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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

GP General Practitioner

Hir Hirschberg test

NICU Neonatal-intensive care unit

PM Pursuit Movements

PPP Purchasing Power Parity

PR Pupillary Reflexes

RE Retinal Examination

ROP Retinopathy of Prematurity

RR Red Reflex Testing

SV Stereopsis

VA Visual Acuity

WHO World Health Organisation

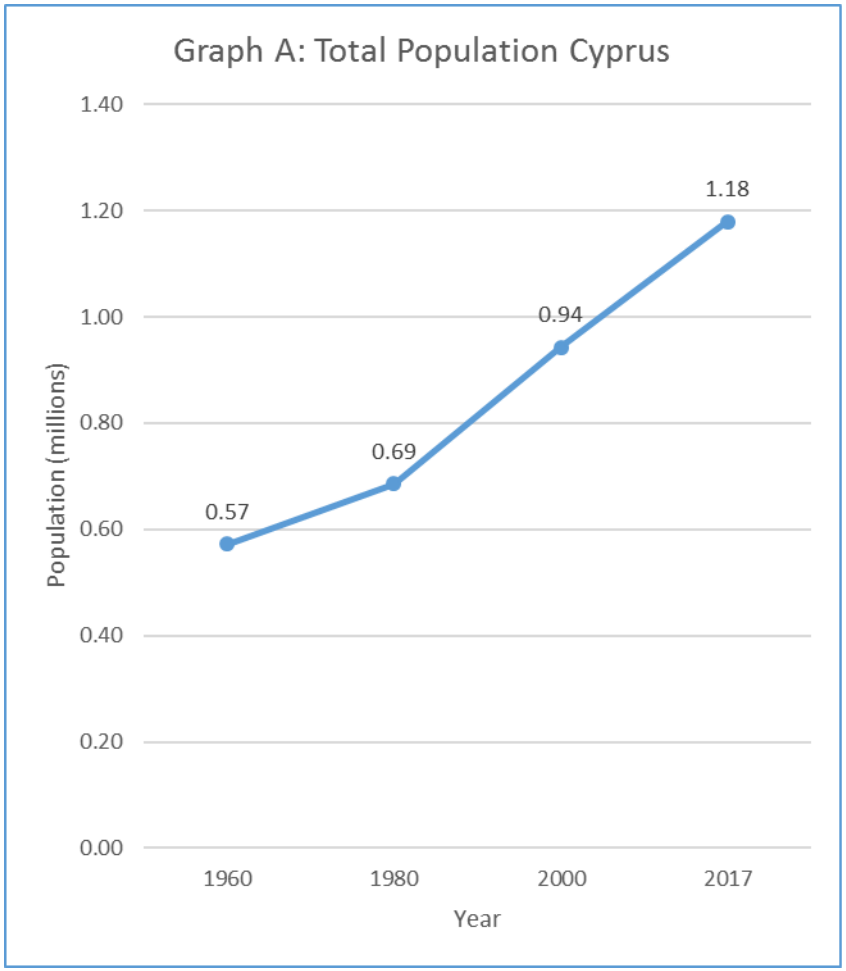
3. Population and Healthcare Overview

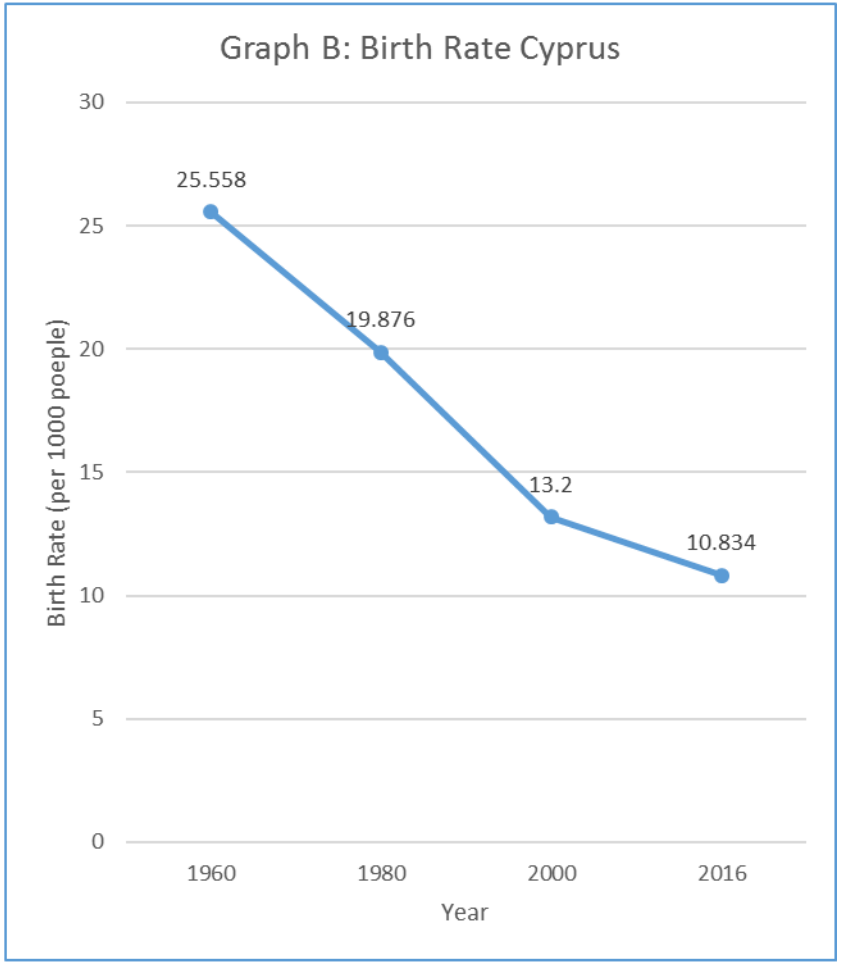
The population of Cyprus is estimated at 1,179,551 (World Bank, 2018a) with a birth rate estimated at 10.8 births/1,000 population in 2016 (World Bank, 2018b. The change in population and birth rate from 1960 to 2017 is shown in Figure 1, graphs A and B respectively.

Cyprus had a reported population density of 127.66 people per square kilometre in 2017 rising from 62.38 people per square kilometre in 1961 (World Bank, 2018c). In terms of healthcare facilities, the total density of hospitals in 2013 was 7.54 per 100,000 population (WHO, 2016a). Infant mortality in 2017 was estimated at 2.1 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Cyprus is estimated at 80.5 years (World Bank, 2018e), with a death rate 6.89 deaths/1,000 population in 2016 (World Bank, 2018f). Cyprus has a gross national income per capita (PPP int. $, 2013) of $28,000 (WHO, 2016b). The estimated total expenditure on health per capita in 2014 was $2,062 (Intl $) and the total expenditure on health in 2014 as percentage of GDP was 7.4% (WHO, 2016b).

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





Source: Information sourced from World Bank (2018)

4. Vision Screening Commissioning and Guidance

Vision screening in Cyprus is organised nationally, with no regional differences in protocols. It is not clear when the vision screening programme started or exactly how the vision screening programme has been changed since its implementation although the addition of colour vision testing was implemented in recent years. Within the public sector, vision screening guidelines are part of the national general health screening guideline which is revised yearly by the Ministry of Health. Production of guidelines and updates are funded by the government.

Vision screening is embedded into a general preventative child healthcare screening system and funded by parents, the state, charity, or the parents' employer and. Vision screening is only free for parents if it is conducted in public schools. Parents can choose to pay for vision screening through private clinics. The content of the public-sector vision screening is set out by the Ministry of Health which offers vision screening at the age 6 years. In the private sector, the decision is made by the professional carrying out the vision screening. Public-sector vision screening is available in all public schools at the age of 6 years. In Nicosia, there is also a mother and child centre at the public hospital which screens children under its care at 4 years old. It depends on the parents if they chose to do a private check at 3 years of age, take the child to this centre, or wait for the screening at schools. It is not dependent on the financial ability to pay.

Vision screening is conducted in hospitals, private clinics, kindergarten and schools, by optometrists, orthoptists, specialist nurses, youth doctors and health visitors. There are 91 vision screening professionals in Cyprus and 2 private orthoptists. Nurses and optometrists are professionals that do not currently perform vision screening screen, but could do so with additional training. In the public sector, health visitors are trained by ophthalmologists and other eye health professionals in seminars and workshops. In the private sector, no training is provided, ability to screen is dependent on having the correct qualifications. Orthoptists and optometrists do not undertake any specific training aside from their general professional training. It is unclear how long the training is per professional. Training is updated, monitored or revalidated on a yearly basis. There is no specific screening accreditation or certification, aside from the qualifications gained through professional training which are all certified by the university or college diplomas.

Quality monitoring is carried out within the public sector through an internal assessment system. There are administrators who determine compliance in each county. These individuals check once or twice a year, how tests are carried out and if the health visitor is carrying out procedures. There are no official guidelines for analysing results to determine false positives or false negatives. In the private sector, there is much more detailed testing, but there is no quality monitoring. There is no research concerning the vision screening programme carried out in Cyprus, there has been no cost-effectiveness analysis and no other studies concerning the effectiveness of the vision screening programme in Cyprus.

5. Screening programme

In Cyprus, the target conditions screened for by vision screening are retinopathy of prematurity (ROP), congenital ocular defects, amblyopia, reduced visual acuity, colour vision defects and strabismus. There are vision screening guidelines, but no protocol available in Cyprus, vision screeners are able to use their own discretion and experience. 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, up to the age of 3 months are screened in the public sector by a specially trained ophthalmologist in a private clinic. The vision screening tests conducted include eye inspection, fixation, red reflex testing, retinal examination and pupillary reflexes. There is no specific protocol for the timing or frequency of this screening in premature infants.

5.2 Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician, or an ophthalmologist in a private clinic. The vision screening tests conducted may include eye inspection, fixation, red reflex testing and pupillary reflexes, however, there is no protocol and this varies between professionals. There is no specific protocol for the timing or frequency of these tests. The number of abnormal test results that determine referral for further examination is decided upon by the specialist conducting the vision screening; this is usually after one abnormal result and 1 or 2 inconclusive tests.

5.3 Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by either an ophthalmologist, specialist nurses or an orthoptist in either a hospital or a private clinic. The vision screening tests conducted include eye inspection, fixation, red reflex testing, eye motility, retinal examination, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis (stereo fly test, Lang or Titmus; this varies between professional) and automated screening (device not known, but only conducted in the private sector). The tests carried out are not controlled, and therefore depends on the discretion of the professional. There is no particular order in which these vision screening tests are conducted. Visual acuity can be measured for the first time between 6 months to 1 year of age, depending on if and when the child is referred for a visual screening. Visual acuity measurement is carried out by either an orthoptist in private care, or specially trained nurse in the public sector. One abnormal test necessitate referral for further diagnostic examination and 2or 3 inconclusive tests are needed for referral.

5.4 Vision screening - 36 months to 7 years

Children aged 36 months to 7 years may be screened in either public or private-sector services. Public screening is carried out by health visitors, specialist nurses, or youth doctors in schools or hospitals. Private screening is conducted by an orthoptist, ophthalmologist, or an optometrist in a private clinic. Vision screening is conducted every two years between the ages of 36 months and 7 years.

The vision screening tests utilised in this age group include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis, colour vision, autorefraction, automated screening and retinoscopy. The tests conducted by each service vary as follows:

- Public sector: health visitor at school or youth doctor/specialist nurse in hospital: VA and at times colour vision
- Private sector: Ophthalmologist, orthoptist and/or optometrist in a private clinic: all tests listed above.

The number of abnormal test results that determine if a child is referred for further diagnostic examination is determined by the practitioner, there is no protocol but it is usually one. The number of inconclusive tests that determine referral for further diagnostic examination is between 2 and 3. Visual acuity is measured for the second time 2 years subsequent to the first examination from the age of 2.5 to 3.5 years. The charts used by each professional include:

- Cardiff cards – orthoptists
- Kays, Keeler, Snellen - orthoptists, optometrists, ophthalmologists
- Snellen - health visitors at the schools

The specific range of testing levels for each chart used are:

- Cardiff cards 6/72 - 6/6
- Kays single pictures 3/30 - 3/3
- Kays crowded pictures 3/30 - 3/2.4
- Keeler Crowded logMAR books 6/38 - 6/3
- Snellen chart 6/60 - 6/5

The age at which each chart is used are:

- 6-18 months - Cardiff Cards
- 18 months to 2.5 years - Kays single picture test
- 2.5 to 4.5 years - Crowded Kays Picture test
- 4.5 to 6 years - Keeler Crowded LogMAR books
- 6 years and over - Snellen chart

The referral criteria per age category are as follows:

- 0-1year - lack of fixing and following and visual responses, lower recorder level of acuity for age
- Over 1 year of age - lack of fixing and following and visual responses, lower recorder level of acuity for age, and 2 lines difference in visual acuity.

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

Table 1	**Paediatrician**	**Ophthalmologist**	**Orthoptist**	**Specialist Nurse**	**Optometrist**	**Youth Doctor**	**Health Visitor**
Preterm babies	×	✓	×	×	×	×	×
0 to 3 months	✓	✓	×	×	×	×	×
3 to 36 months	×	✓	✓	✓	×	×	×
3 to 7 years	×	✓ Private Sector	✓ Private Sector	✓ Public Sector	✓ Private Sector	✓ Public Sector	✓ Public Sector

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

Table 2	EI	RR	Fix	EM	Hir	RE	PM	PR	CT	ACT	VA	SV	CV	AR	AS
Preterm babies	✓	✓	✓	×	×	✓	×	✓	×	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	×	×	×	×	✓	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	×	✓	×
3 to 7 years	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Priv. Sector	✓ Public Sector	✓ Priv. Sector	✓ Public Sector	✓ Priv. Sector	✓ Priv. Sector

Key: *EI: Eye inspection; RR: Red reflex testing; Fix: Fixation; EM: Eye motility; Hir: Hirschberg test; RE: Retinal exam; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover test; ACT: Alternating cover test; VA: Visual acuity measurement; SV: Stereoscopic Vision; CV: Colour vision; AR: Autorefraction; AS: Automated screening; Priv. Sector: indicates tests performed within the private sector only*

Table 3: Location of vision screening for each age group

Table 3	**Hospital**	**School**	**Private Clinic**
Preterm babies	×	×	✓
0 to 3 months	×	×	✓
3 to 36 months	✓	×	✓
3 to 7 years	✓ Public Screening	✓ Public Screening	✓ Private Sector

6 Automated Screening

Automated vision screening is achieved using handheld, portable devices designed to detect presence of refractive error 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 Cyprus, PlusOptix is used as the automated vision screening device, but this is only conducted in some private clinics, it is not a universal screening tool. The cost of this device is 7000-8000 Euros, it is not known how many devices there are in Cyprus. It is estimated that after 5to 7 years, the device needs to be replaced.

7 Provision for Visually Impaired

In Cyprus, there is one school for blind or severely visually impaired children, this is located in Nicosia. It accommodates only 7 children with multiple disabilities. All others are integrated into mainstream school with low vision aids and tools provided.

The costs per child are not specifically known, however, it is suggested that a child could cost between 500 Euros and 1000 Euros. This depending on the equipment needed - such as low vision aids to see the board, reading software for magnifying on a laptop and even payment of the laptop. Blind children receive up to 850 euros in funding per month.

8 Knowledge of existing screening programme

8.1 Prevalence/Diagnosis

The prevalence of treated and untreated amblyopia, at the age of 7 years in estimated at around 2-4%; although there is no specific research to determine this. The prevalence of persistent amblyopia (missed by screening or failed treatment), at the age of 7 years is estimated at less than 1% of children with a visual acuity of less than 6/12 Snellen in the worst eye. The prevalence of strabismus is estimated at 3% before the age of 4 years, but there is no data to back this up. There is limited data pertaining to the incidence of the four types of amblyopia (strabismic, refractive, combined mechanism and deprivation) in Cyprus.

8.2 Coverage

All children are invited for vision screening in the public sector, but not all receive the private sector screening. The percentage of children invited for vision screening is estimated as 80-90%. The vision screening invitation is sent out by the Ministry of Health via a letter to all 6 year olds who are being tested at school by a health visitor, or parents are told during a routine visit to the paediatrician. Screening evaluation

The percentage of compliance with referral after an abnormal school screening test result is estimated at 80%. For private practice screenings, it is up to the parents to follow so there is no firm data available. There is no registration or documentation of noncompliance with referral after an abnormal screening test result.

The coverage of any kind of vision screening before the age of 7 years is estimated at 80 to 90%. The attendance rates of vision screening before the age of 7 years is estimated at 30% in private kindergartens (where parents pay for screening) and in the public sector this is around 70 to 80%. The coverage of visual acuity measurements as part of vision screening, before the age of 7 years, is estimated at around 80%. The attendance rate of visual acuity measurements as part of vision screening, before the age of 7 years, is estimated at between 80-90%. There is no data to back this up.

8.3 Screening Evaluation

The percentage of false negatives and false positives for vision screening after the screening is completed is not known, however, it is suggested that this would be very rare. The positive predictive value of a ‘refer’ result after vision screening is estimated at 80-90%. There is no data available to determine the sensitivity or specificity of vision screening in Cyprus.

8.4 Treatment success

The percentage of infants treated for congenital eye disorders in the total population is not reported. The percentage of children treated for strabismus, after being screened, before the age of 7 years is estimated at 3-4%, which rises to 3-5% of all children, when including those not screened before the age of 7 years. The percentage of children treated for amblyopia after being screened or if they were not screened, before the age of 7 years is estimated as 3%. The distribution of the four types of amblyopia is not known.

The number of patients treated for congenital cataract, amblyopia and strabismus, each year, by an orthoptist and/or ophthalmologist, is difficult to determine; many patients (around 80%) do this privately and as such there is no data. However, in the public sector there are 3 to 4 per year for congenital cataracts and strabismus surgery per hospital.

Only ophthalmologists and optometrists prescribe glasses for children under the age of 7 years, after referral from screening. Other treatment options include patching and penalisation with glasses. All eligible children are offered treatment.

9 Costs of vision screening in children

9.1 Cost of vision screening

The salary costs per year for vision screening professionals is not known for the public sector or private sector. The salary costs per hour for vision screening professionals is estimated at 20 Euros per hour for health visitors, 50 Euros per hour for optometrists and orthoptists and 100 Euros per hour for ophthalmologists. The cost of training general preventative child healthcare screening professionals, between leaving secondary education to qualification is not known. The total screening costs per year are not known. The total costs per child per year for vision screening is estimated at 10-40 Euros in the private sector, which is paid by the parents. The cost in the public sector is not known as this is not covered by parents.

9.2 Cost of treatment for amblyopia

The estimated costs for treatment of typical patients with refractive amblyopia or strabismic amblyopia, including follow-up, is estimated based upon the fact that most patients are seen 4 times a year (patients/parents have to pay for this):

- Cost of patches: 200 Euros/year x4 = 800 Euros
- Cost of glasses: 100 Euros/year x4 = 400 Euros
- Cost of private visits: 150-300 Euros/year (combination of orthoptist and ophthalmologist) x 4 years = 600-1,200 Euros
- Cost of public visits: 30 Euros/year x4 = 120 Euros

Approximately between 1,320 Euros for public and between 1,800-2,400 Euros for 4 years of treatment and aftercare. If the follow-up is at the hospital, children will be seen by orthoptists and ophthalmologists for a fee of 6 Euros. Furthermore, in private practice, an orthoptist appointment is approximately 40 Euros per visit and an ophthalmologist approximately 50 Euros per visit.

9.3 Cost of Treatment for strabismus

The estimated cost of strabismus surgery, including follow-up is 3,000 Euros for the surgery, this might include follow-up for a year and then it depends on the case. This is free to the patient. An ophthalmologist will monitor the vision with an orthoptist or until the age of 6 years old, which costs approximately 60-80 Euros per visit, 3-4 visits per year.

9.4 Cost of treatment for cataract

The estimated costs for congenital cataract surgery, including follow-up of deprivation amblyopia, is estimated at 4,000 Euros for the surgery which might include follow up for a year and then it depends on the case. An ophthalmologist will monitor the vision with an orthoptist or optometrist until the age of 6 years old. This is approximately 60 Euros per

visit, with 3-4 visits per year. Vision screening is only free for parents if it is conducted in public schools. Parents can choose to pay for vision screening through private clinics.

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