



Summary: Vision Screening

Paolo Mazzone, Helen Griffiths, Jill Carlton

University of Sheffield, United Kingdom

This summary report contains key information from 46 Country Reports.

The full reports can be found here: <https://www.euscreen.org/vision-screening-country-reports>

Disclaimer: This is a summary report representing the responses from a country representative working within eye care services of the country reported. This report does not represent conclusions made by the authors, and is the product of professional research conducted for the EUSCREEN study. It is not meant to represent the position or opinions of the EUSCREEN study or its Partners. The information cannot be fully verified by the authors and represent only the information supplied by the country representatives.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 733352

Table of Contents

Glossary of Terms: Vision Screening	4
Abbreviations	7
1. Albania	8
2. Austria	12
3. Belgium	16
4. Bosnia and Herzegovina	22
5. Bulgaria	26
6. China	29
7. Croatia	33
8. Cyprus	37
9. Czech Republic	42
10. Denmark	46
11. England & Wales	49
12. Estonia	55
13. Faroe Islands	59
14. Finland	63
15. France	67
16. Germany	71
17. Greece	75
18. Hungary	79
19. Iceland	84
20. India	88
21. Ireland	93
22. Israel	97
23. Italy	102
24. Kosovo	106
25. Latvia	110
26. Lithuania	115
27. Luxembourg	119

28.	Malawi	123
29.	Malta	126
30.	Moldova	129
31.	Montenegro	133
32.	Netherlands	136
33.	North Macedonia	141
34.	Northern Ireland	145
35.	Norway	149
36.	Poland	153
37.	Romania	156
38.	Rwanda	161
39.	Scotland	163
40.	Serbia	168
41.	Slovakia	173
42.	Slovenia	177
43.	Spain	181
44.	Sweden	185
45.	Switzerland	189
46.	Turkey	194

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	<p>The proportion of all those invited for screening that are tested and receive a result:</p> <ul style="list-style-type: none"> • 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”. <p>Attendance rate provides information on the willingness of families to participate in screening.</p>
Compliance with referral (percentage)	<p>The percentage of those who are referred from screening to a diagnostic assessment that actually attend the diagnostic assessment.</p> <p>Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.</p>
Coverage	<p>The proportion of those eligible for screening that are tested and receive a result:</p> <ul style="list-style-type: none"> • 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”. <p>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.</p>
False negatives	<p>The percentage of children with a visual deficit (defined by the target condition) that receive a result of “pass” during screening.</p> <p>Example: If 100 children with visual deficit are screened, and 1 child passes the screening, the percentage of false negatives is 1%.</p>
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	<p>The percentage of children referred from screening who have a confirmed vision loss.</p> <p>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%.</p>
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	<p>All infants that are considered to be at-risk or have risk-factors for vision defects/ophthalmic pathology according to the screening programme.</p> <p>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.</p>
Sensitivity	<p>The percentage of children with visual defects that are identified via the screening program.</p> <p>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%.</p>

Specificity	<p>The percentage of children with normal vision that pass the screening.</p> <p>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%.</p>
Target condition	<p>The visual defect you are aiming to detect via the screening programme.</p>
Well, healthy babies	<p>Infants who are <i>not</i> admitted into the NICU or born prematurely (born after a gestation period of less than 37 weeks).</p>

Abbreviations

AAO – American Academy of Ophthalmology

GDP – Gross Domestic Product

ICO – International Council of Ophthalmology

NICU – Neonatal-intensive care unit

PPP – Purchasing Power Parity

WHO – World Health Organisation

1. Albania

Vision screening representative for Albania: Dr. Alketa Tandili, University of Medicine, Tirana.

1.1. Vision Screening Commissioning and Guidance

Vision screening in Albania is funded through national health insurance and is not embedded into general preventative child healthcare screening. There are no guidelines for ophthalmologists to follow however, they are guided by the American Academy of Ophthalmology (AAO) and International Council of Ophthalmology (ICO) guidelines. The content of the Albanian vision screening programme is decided upon by the Ministry of Health and was implemented nationally in 2013, with no changes since its commencement.

Vision screening is conducted by ophthalmologists, nurses, or paediatricians. No other general health care professionals have been identified that do not currently screen, but could do so with additional training. There is no specific training provided for vision screening; ophthalmologists undertake a 4-year residency where they acquire the skills and knowledge to perform such tasks.

Vision screening is conducted in hospitals or primary service. It is not known how often the vision screening programme is reviewed, who decides upon revisions, how revisions are funded, or how the revisions take place.

There are no methods imposed by the government regarding quality monitoring of the vision screening programme, but there has been some PhD research concerning the programme, the details of this research have not been shared and therefore the content is not known. There has been no cost-effectiveness analysis conducted pertaining to the vision screening programme, nor studies on the effectiveness of vision screening in Albania.

1.2. Screening Programme

In Albania, retinopathy of prematurity, congenital eye defects and amblyopia are the target conditions screened for by vision screening. 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 the sections below.

1.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened using an eye inspection. This vision screening is conducted by an ophthalmologist in either a maternity clinic or an eye clinic.

1.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened using an eye inspection and red reflex examination. These tests are conducted by an ophthalmologist or a nurse in either a hospital or primary service. Paediatricians or ophthalmologists perform the fundus red reflex examination to diagnose white pupil. The timing and number of eye screenings offered during this 3 month period is not clearly defined and it is not known after how many abnormal or inconclusive tests a baby is referred for further diagnostic examination.

1.2.3. Vision screening - 3 months to 36 months

Vision screening is conducted on children aged 3 months to 36 months by an ophthalmologist at an eye clinic. It is not clear what vision screening tests are performed in children aged 3 months to 36 months. It is known that a visual acuity measurement is conducted at the age of 2 years, although the method of measurement is not clear and the sequence of testing during this period or the referral criteria are not known.

1.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened by either an ophthalmologist or a paediatrician in a primary care clinic, using an eye inspection and an unspecified 'other' test. The timing and frequency of vision screening at any other age between 36 months and 7 years is not known and it is not known after how many abnormal or inconclusive tests a child is referred for further diagnostic examination. Visual acuity is measured at age 3 to 4 years by an ophthalmologist, using Lea Symbols, HOTV, Keeler, Snellen, Allen Cards or Numbers. Visual acuity is repeated at ages 6 to 7 years. It is not known how many abnormal or inconclusive tests necessitate a child to be referred for further diagnostic examination.

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

	Paediatrician	Ophthalmologist	Nurse
Preterm babies	×	✓	×
0 to 3 months	✓	✓	✓
3 to 36 months	×	✓	×
3 to 7 years	✓	✓	×

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

	Eye inspection	Red Reflex testing	Visual Acuity measurement	Other
Preterm babies	✓	×	×	×
0 to 3 months	✓	✓	×	×
3 to 36 months	×	×	✓	×
3 to 7 years	×	×	✓	✓

Table 3: Location of vision screening for each age group

	Maternity	Eye Clinic	Hospital	Primary Care Clinic
Preterm babies	✓	✓	×	×
0 to 3 months	×	×	✓	✓
3 to 36 months	×	✓	×	×
3 to 7 years	×	×	×	✓

2. Austria

Vision screening representative for Austria: Dr Andrea Langmann, University Hospital, Graz.

2.1. Vision Screening Commissioning and Guidance

Vision screening in Austria, is organised nationally, with nine regions individually organising kindergarten projects. The nine regions are Burgenland, Carinthia, Lower Austria, Upper Austria, Salzburg, Styria, Tyrol, Vorarlberg and Vienna. These kindergarten projects include vision screening by photorefractors, which are organised by the kindergarten itself, the federal government, or photoscreener distributors.

In Austria, each pregnant woman is given a mother-child health passport. This allows the doctor to enter all important examinations up to the age of 5-years. This procedure is the same in all 9 regions, although the execution of the recommended screening examinations might differ as these are only recommendations, not guidelines.

The national vision screening programme is embedded into a general preventative child health care screening system. Ophthalmologists, paediatricians, general practitioners (GP) and opticians conduct vision screening. There are 1355 paediatricians, 926 ophthalmologists, 14,130 GPs within Austria, it is unknown how many opticians there are. No other general health professionals have been identified who currently do not perform vision screening but could do so with additional training. There is no specific training available. Vision screening takes place within hospitals or in the offices of an ophthalmologist, paediatrician or GP.

Vision screening is funded either privately or through the mother child pass programme which provides health care funded two-thirds from federal funds and one-third from social security funds. Additional projects are funded by non-profit organisations, the federal government, or the distributors of photoscreeners.

The content and any reviews of the vision screening programme are decided upon by a Mother-Child-Passport Programme expert group. These revisions are undertaken by the Ministry of Health according to actual data, reviews and Health Technology Assessments (HTAs). The vision screening programme was implemented nationally in 1974 as part of general screening. This was updated in 1987 with the addition of ophthalmic examinations.

There are no specific guidelines for vision screening, but there are some “low-level” recommendations from the Consilium Strabologicum Austriacum (CSA), a team of specialists from the Austrian Ophthalmological Association. There are methods for quality monitoring imposed by the government determined according to actual data collected, reviews of literature, HTAs and expert opinion.

There is no research carried out in Austria regarding the vision screening programme. However, there have been cost-effectiveness analyses about the vision screening programme, but this is for local/regional projects only; there is no information available about these analyses.

2.2. Screening programme

In Austria, anomalies of the eye, amblyopia and pathologies are screened for by vision screening. 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 the sections below.

2.2.1. Vision screening - Preterm babies

Preterm babies are screened by ophthalmologists using retinal examination (indirect ophthalmoscopy). This is conducted within departments of neonatology at children hospitals. The number of abnormal or inconclusive test results before referral for further diagnostic examination are not specified, this is at the discretion of the screener. Referral criteria for preterm babies are based on literature, there are no specified guidelines.

2.2.2. Vision screening - Birth to 3 months

Screening takes place at ages 1 week and then again between 4 to 7 weeks. Vision screening is conducted at the offices of either a paediatrician or GP, or in hospitals. The Bruckner red reflex fundus test and eye inspection are recommended for well, healthy babies up to the age of 3 months; however, some clinicians use only a flashlight. Any abnormality in visual behaviour, including red reflex, strabismus, or the anatomy of the eye will result in the child being referred. The number of abnormal test results that necessitate a baby being referred is not defined, it is entirely dependent upon the clinician; the same is true for inconclusive tests, it is at the discretion of the clinician.

2.2.3. Vision screening - 3 months to 36 months

Children aged between 3 and 36 months of age are screened four times by a paediatrician, or GP at either the paediatrician's office or hospital. Children are tested between 3 and 5 months of age, then again between 7 to 9 months, 10 to 14 months. Children aged 24 months are screened by an ophthalmologist. The tests conducted include eye inspection, red reflex, fixation, eye motility, retinal examination, pursuit movements, cover test and they are also screened for risk factors using automated devices (see Section 7). The referral criteria are stated as any abnormality in visual behaviour, red reflex, strabismus, or the anatomy of the eye.

2.2.4. Vision screening - 36 months to 7 years

Paediatricians, GPs, ophthalmologists, orthoptists, or opticians conduct vision screening in either the paediatrician's office, hospital, or at school. The sequence of vision screening in children aged between 36 months and 7 years is at 34-38 months, then again at 46 to 50 months, and again between 58 and 62 months. The recommended tests conducted at this age include visual acuity measurement, stereopsis and accommodation. Visual acuity is measured from the age of 3 years by a paediatrician, GP or ophthalmologist. Lea symbols are recommended as the optotype chart to be used during this visual acuity measurement, but there are no specific guidelines, and therefore some clinicians may use different visual acuity tests. Children are referred immediately after an abnormal test, although there is no defined protocol for how many inconclusive tests determine a referral. Referral criteria is stated as any abnormality in visual behaviour, red reflex, strabismus, or the anatomy of the eye.

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

	Paediatrician	Ophthalmologist	Orthoptist	GP	Optician
Preterm babies	×	✓	×	×	×
0 to 3 months	✓	×	×	✓	×
3 to 36 months	✓	✓	×	✓	×
3 to 7 years	✓	✓	✓	✓	✓

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

	EI	RR	Fix	EM	RE	PM	CT	AR	VA
Preterm babies	×	×	×	×	✓	×	×	×	×
0 to 3 months	✓	✓	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓	✓	×	×
3 to 7 years	✓	×	×	×	×	×	✓	✓	✓

Key:

EI: Eye Inspection; RR: Red reflex testing; Fix: Fixation; EM: Eye Motility; RE: Retinal examination; PM: Pursuit movements; CT: Cover Test; AR: Autorefracton; VA: Visual Acuity Measurement

Table 3: Location of vision screening for each age group

Table 3	Hospital	Paediatrician office	School
Preterm babies	✓	×	×
0 to 3 months	✓	✓	×
3 to 36 months	✓	✓	×
3 to 7 years	✓	✓	✓

3. Belgium

Vision screening representative for Belgium: Dr Demet Yuksel, Institute of Neuroscience, Université Catholique de Louvain.

3.1. Vision Screening Commissioning and Guidance

Vision screening is organised regionally; the three regions of Wallonia, Flanders and the German speaking region, all provide vision screening. They each have different protocols; such as the age at which tests are conducted, the tests used and the professionals administering the tests. In Wallonia (South Belgium), vision screening began in 2004; in Flanders, vision screening began in 2013. It is not known when vision screening began in the German speaking community (on the Eastern border). The guidelines for vision screening are included within each of the regional general health screening guidelines. None of the vision screening programmes have changed since implementation, however discussions on their content are scheduled for 2019.

Vision screening is offered free of charge for parents. Each region must have at least 80 births in the latest year; if that is not achieved, children are invited to attend centres in another region.

There were no orthoptic training schools and therefore nurses and GPs were trained to undertake vision screening. A total of forty GPs and paediatricians have been trained by ONE, between 2004 and 2016, it is not known how many more are needed. Training for general professionals occurs annually, organised by ONE and taught by an ophthalmologist. The training is not accredited or certified. In 2016, an orthoptic training programme opened in Liege and there are another two courses in preparation in Brussels and Gent. The training for orthoptists is a Bachelor's degree which takes 3 years, therefore additional orthoptists will graduate to enter the workforce in 2019. These new graduate Orthoptists have been identified as professionals that do not screen, but could do so ;.

Vision screening is funded independently by each region and therefore there are differences in the provision. Vision screening is embedded into a general preventative child healthcare screening system, the content of which is decided upon by ONE (for Wallonia) and the local government advised by a committee directed by paediatricians in collaboration with ophthalmologists and orthoptists.

Data is collected monthly about the activity of the vision screeners. This includes where screening has taken place, the type of vision screening, the number of children screened, the number of normal results, the number of abnormal results, the number of doubtful results and the number of unfeasible results. Annual charts are created, the results of which are sent back to the vision screeners to be analysed. There are methods for quality monitoring imposed by the government; specifically, the collection of data is done on an anonymous basis. The outcome from the ophthalmologist visit (diagnostic testing of those referred) are documented and collected from the ophthalmologists, the parents, or the director of the kindergarten, school

or health centre and sent back to ONE. There has been no research concerning the cost- or clinical-effectiveness of the vision screening programme in Belgium.

3.2. Screening programme

Retinopathy of prematurity, congenital eye disorders and amblyopia are the target condition screened for by vision screening. The criteria for referral for further diagnostic examination for preschool children (before the age of 2.5 years) is detailed relating to each region (different methods of screening and also different choices made by each committee). 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 the sections below.

3.2.1. Vision screening - Preterm babies

Preterm babies, up to the age of 3 months, are screened in a hospital by an ophthalmologist. The vision screening tests used include eye inspection, fixation and pupillary reflexes. Babies are referred immediately if there are signs of abnormality. There are no specific guidelines.

3.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened in either a hospital, child healthcare centre, private clinic or private medical practice. The tests are carried out by either a GP or paediatrician. The vision screening tests used include eye inspection, fixation and pupillary reflexes, observation for facial asymmetry or palpebral asymmetry. An ophthalmologist will conduct fundus red reflex examination, only if there are signs of amblyopia. In all regions babies are referred immediately if there are signs of abnormality.

3.2.3. Vision screening - 3 months to 36 months

Flanders

Babies aged 3 to 36 months are screened in medical consultations organised by Kind en Gezin (K&G). An eye test completed by specialist nurses is carried out at 12 to 15 months of age and then again at 24 to 30 months of age.

Flanders referral criteria

- Hypermetropia: $HM \geq +4$ Dioptres
- Myopia: ≥ -4 Dioptres
- Astigmatism: 12 Months >3 Dioptres; 24 Months: >2.5 Dioptres
- Anisometropia: sph/cyl >1.5 Dioptres
- or no detection of a pupil

Wallonia

Babies aged 3 months to 36 months are screened in medical consultations organised by Office de la naissance et de l'enfance (ONE, The Office of birth and childhood). One test is carried out between 18 to 47 months of age by orthoptists, general practitioners, paediatricians or specially trained nurses.

Wallonia referral criteria

- Hypermetropia: $HM \geq +1.5$ Dioptres
- Myopia: > -3 Dioptres
- Astigmatism: >2 Dioptres
- Anisometropia: sph/cyl >2 Dioptres
- or anomaly on one of the following items: inspection, corneal reflexes, biprism Gracis (specific test with 6DP base out and base in in one compact device), cover test, ocular motility

German-speaking community

Between 3 to 36 months children are screened in medical consultations organised by Kaleidoscope. At around 30 months of age, children are screened by orthoptists or ophthalmologists. The vision screening tests utilised include eye inspection, fixation, eye motility, Hirschberg, pupillary reflexes, cover test, visual acuity measurement, stereopsis (Lang I or II), colour vision, autorefraction (Retinomax Autorefractor), or automated screening (PlusOptix).

German-speaking community referral criteria

- Hypermetropia: $HM \geq +1.5$ Dioptres
- Myopia: ≥ -3 Dioptres
- Astigmatism: >2 Dioptres
- Anisometropia: sph/cyl >2 Dioptres
- or anomaly on 1 of the following items: inspection, corneal reflexes, pupil reflexes, Lang stereotest, biprism Gracis, cover test, ocular motility

3.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened at a Médecine Scolaire (Medical School). Vision screening is conducted by either a paediatrician, specialist nurse, orthoptist, or technical assistant in ophthalmology. The vision screening tests utilised at this age include eye inspection, eye motility, Hirschberg, pupillary reflexes, cover test, visual acuity measurement, stereopsis, autorefraction (Retinomax Autorefractor), or automated screening (PlusOptix), biprism of Gracis (Wallonia only). The optotype charts used to measure visual acuity include Lea Symbols, Crowded Kay pictures, Keeler logMAR crowded test performed at 3m, Snellen optotypes, E-test, Stycar and Paris near vision test. Visual acuity is measured for the first time at 3 years of age, and for a second time between the ages of 5 and 6 years. Visual acuity is measured in Flanders by specialist nurses, paediatricians, or a GP with master of youth health; in Wallonia by specialist nurses, paediatricians, or GPs with "certificat d'université-médecine

soclaire-PSE" (certificate from a university/school of medicine-PSE); in German-speaking community by specialist nurses, paediatricians, or GP some with education in school medicine. Children are referred to an ophthalmologist after one abnormal or one inconclusive test result.

For all regions, the children are not tested at a specific age but in a certain class:

- 1st year of kindergarten approx. 3 years
- 2nd year of kindergarten approx. 4 years
- 1st year of primary school approx. 6 years
- 3rd year of primary school approx. 9 years
- 4th year of primary school approx. 10 years
- 5th year of primary school approx. 11 years
- 6th year of primary school approx. 12 years

Flanders referral criteria:

- 1st year of Kindergarten: <0.63 (decimal) Kay test or <0.5 (decimal) logMAR test
- 2nd year of Kindergarten: <0.63 logMAR test (Keeler Crowded) or Kay test (Picture crowded book)
- 1st year of primary school: <0.8 (decimal) logMAR test
- 3rd year of primary school: <0.8 logMAR test (or Snellen test)
- 5th year of primary school: 1 line interocular difference, anomaly of ocular alignment, repeated failed measurement in cooperative child

Wallonia referral criteria:

- 1st year of Kindergarten: <0.6 (decimal) or smallest line not correctly performed (Paris near vision test)
- 3rd year of Kindergarten: <0.8 (decimal)
- 2nd year of Primary school: <0.8 (decimal)
- 4th year of Primary school: <0.8 (decimal)
- 6th year of Primary school: 1 line interocular difference or anomaly of ocular alignment or repeated failed measurement in cooperative child

German-speaking community referral criteria:

- 1st year of Kindergarten: <1.0 (decimal)
- 2nd year of Kindergarten: <1.0 (decimal)
- 1st year of Primary school: <1.0 (decimal)
- 3rd year of Primary school: <1.0 (decimal)
- 5th year of Primary school: <1.0 (decimal)
- or at any age: anomaly of ocular alignment or stereopsis or repeated failed measurement

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

	Ophthalmologist	Paediatrician	GP	Orthoptist	Specialist Nurse	Technical assistant in ophthalmology
Preterm babies	✓	×	×	×	×	×
0 to 3 months	✓	✓	✓	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓
3 to 7 years	×	✓	×	✓	✓	✓

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

	EI	Fix	PR	EM	Hir	CT	VA	SV	AR	AS	BG	CV
Preterm babies	✓	✓	✓	×	×	×	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	×	×	×	×	×	×	×	×	×
3 to 36 months	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓*	✓
3 to 7 years	✓	×	✓	✓	×	✓	✓	✓	✓	✓	✓*	✓

* Wallonia

Key:

EI: Eye Inspection; Fix: Fixation; EM: Eye Motility; Hir: Hirschberg; PR: Pupillary Reflexes; CT: Cover Test; VA: Visual Acuity Measurement; SV: Stereopsis; CV: Colour Vision; AR: Autorefraction; AS: Automated Screening; BG: Biprism of gravis; CV: Colour vision

Table 3: Location of vision screening for each age group

	Hospital	Child health care centre	Private clinic	Private practice	Medical School	ONE	K&G	Kaleidoscope
Preterm babies	✓	×	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	✓	×	×	×	×
3 to 36 months	×	×	×	×	×	✓ *	✓ **	✓ ***
3 to 7 years	×	×	×	×	✓	×	×	×

* Wallonia

** Flanders

*** German community

Key:

ONE: Office de la naissance et de l'enfance (The Office of birth and childhood)

K&G: Kind en Gezin - an organisation subsidized by the government

4. Bosnia and Herzegovina

Vision screening representative for Bosnia and Herzegovina: Dr Amra Nadarevic Vodencarevic, Ophthalmologist, University of Tuzla.

4.1. Vision Screening Commissioning and Guidance

Vision screening in Bosnia and Herzegovina is organised regionally and is divided into ten regions (cantons). Each region provides vision screening, however, there are differences in which tests are performed in each area. There are no national guidelines on vision screening. Vision screening is funded in the same way in each region. This is done by a combination of parents, charity, health insurance, municipalities, parents' employer, the state and regional funding. Vision screening is embedded into a general preventative child healthcare system, the content of which is determined by ophthalmologists and the local government.

Vision screening in Bosnia and Herzegovina is conducted by ophthalmologists and orthoptists, of which there are estimated to be around 200 professionals in Bosnia and Herzegovina. Screening takes place in hospitals, child healthcare centres, kindergarten and school. There are no other vision screeners in Bosnia and Herzegovina. There have been no general professionals identified that could screen with additional training; this is due to there being no specific training provided for performing vision screening.

The vision screening programme began in 1992 and since then it has continued from the age at which the child enters school (6 years of age). Since its commencement, the vision screening programme has been extended as more tests have been implemented, although it is not known what extra tests have been added to the programme. The vision screening programme is reviewed every 5 years by the government and ophthalmologists, however, it is not known how the revisions to the vision screening programme take place. Quality monitoring is not carried out. There has been no research conducted in Bosnia and Herzegovina regarding the effectiveness or cost-effectiveness of the vision screening programme.

4.2. Screening programme

In Bosnia and Herzegovina, the target conditions screened for are retinopathy of prematurity (ROP), congenital eye disorders and refractive error. 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 the sections below.

4.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination and pupillary reflexes. These tests are conducted by an ophthalmologist in either a hospital or healthcare centre.

4.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened using eye inspection and red reflex testing. This is not conducted on all children, it is only if the child is in hospital and the parents are interested or if the paediatrician suspects any abnormality. Red reflex examination to diagnose a white pupil is conducted by an ophthalmologist, as is the eye inspection. There is no sequence to these tests and children are referred for further examination after one abnormal test, and one to two inconclusive tests, the exact number of which is determined by the ophthalmologist.

4.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months of age are screened using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pupillary reflexes, cover test, alternating cover test and autorefraction. All of which are performed by an ophthalmologist at either a hospital or a healthcare centre. The referral criteria and the sequence of these tests are not known.

4.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years of age are screened by an ophthalmologist or an orthoptist using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis, colour vision and autorefraction (varies between doctors). Visual acuity is measured using the Amsterdam Picture Chart and Numbers (varies between doctors); this is performed for the first time between the aged of 3 and 4 years. If the child fails the first test, the test is repeated again one month later. If the child passes, the test is repeated one year later.

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

	Ophthalmologist	Orthoptist
Preterm babies	✓	×
0 to 3 months	✓	×
3 to 36 months	✓	×
3 to 7 years	✓	✓

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

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

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg test; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Test; VA: Visual Acuity Measurement; SV: Stereopsis; CV: Colour Vision; AR: Autorefracton

Table 3: Location of vision screening for each age group

	Child Health Care Centre	Hospital
Preterm babies	✓	✓
0 to 3 months	✓	✓
3 to 36 months	✓	✓
3 to 7 years	✓	✓

5. Bulgaria

Vision screening representative for Bulgaria: Dr Stela Dikova, Ophthalmologist, Diagnosis-Consult Centre, 20-Sofia.

5.1. Vision Screening Commissioning and Guidance

Vision screening is not set-up as a national programme in Bulgaria and is organised regionally. Dates that these regional services started and changes to services are not known. Vision screening is conducted as part of charity programmes in different cities and villages, among different age groups and usually in schools. There are no regions in Bulgaria that have a standardised vision screening programme, every charity campaigns are funded by different sources. There are no guidelines for vision screening available in Bulgaria. However, the Ministry of Health in Bulgaria have stated that GPs should perform a visual acuity assessment after the age of 3 years with vision screening embedded into a general preventative child healthcare screening programme.

In Bulgaria, vision screening is performed by ophthalmologists, neonatologists and general practitioners (GP). It is not known how many vision screening professionals there are in Bulgaria, per million population. Not all GPs perform vision screening, and as such, there are some that could do so with additional training. Paediatricians and nurses are also healthcare professionals within the country who could deliver vision screening with additional training. Currently there is no specific training to perform vision screening.

Coverage can differ between cities, schools and kindergartens and the tests used vary; some are using only automated screening, others test visual acuity and more. There are no methods for quality monitoring imposed by the government. There is only one reported paper published on the outcomes of vision screening (Dikova, Dragoev & Chernodrinska, 2015); this does not include cost-effectiveness analysis.

5.2. Screening programme

Target conditions for vision screening have not been identified as there is no protocol for vision screening in Bulgaria. 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 and within different regions are described more fully in the sections below.

5.2.1. Vision screening - Preterm babies

There is no national policy for preterm babies. In the capital cities of Sofia and Plovdiv, a few hospitals screen for retinopathy of prematurity (ROP) by a paediatric ophthalmologist in a hospital. There are RetCams in Sofia, Varne and Ruse. Parents can travel to Sofia or Plovdiv,

if they live in other areas, otherwise no vision screening is conducted. The vision screening tests utilised at this age include red reflex testing and retinal examination, although this should be conducted everywhere, the retinal examination is not performed in all areas.

5.2.2. Vision screening - Birth to 3 months

Well, healthy babies, up to the age of 3 months, are screened once by a neonatologist in a hospital in every region of Bulgaria. The only test utilised at this age is red reflex testing. It is not known how many abnormal or how many inconclusive tests necessitate referral to an ophthalmologist for further examination.

5.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months do not receive any vision screening.

5.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months to 7 years are screened by a GP in the GPs office. The only test utilised at this age is a visual acuity measurement. Referral for further diagnostic examination occurs after one abnormal test result. There is no defined policy for the number of inconclusive results, for example, due to poor cooperation, before referral for further diagnostic examination. There are no specific referral criteria, referral is at the discretion of the GP. The optotype charts used include numbers and Tumbling E, most of which are linear, crowded tests (it is not known if this is logMAR or Snellen format). It is not known at what age visual acuity is measured for the first time, or if it is measured again at any other age.

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

	Neonatologist	Ophthalmologist	GP
Preterm babies	×	✓ *	×
0 to 3 months	✓	×	×
3 to 36 months	×	×	×
3 to 7 years	×	×	✓

* Only in available in Sofia and Plovdiv

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

	Hospital	GP clinic	Public place	Other
Preterm babies	✓	×	×	×
0 to 3 months	✓	×	×	×
3 to 36 months	×	×	×	×
3 to 7 years	×	✓	×	×

Table 3: Location of vision screening for each age group

	Red reflex testing	Retinal examination	VA measurement
Preterm babies	✓	✓ *	×
0 to 3 months	✓	×	×
3 to 36 months	×	×	×
3 to 7 years	×	×	✓

* Not conducted in all areas

6. China

Vision screening representative for China: Dr Dongsheng Yang, Paediatric Ophthalmologist, Children's eye disease and ocular motor institute of Purui Jinan, Purui eye Hospital Group.

6.1. Vision Screening Commissioning and Guidance

Vision screening in China is organised regionally by each district, with the exception of rural areas which do not provide vision screening. There are differences in protocols between each district; this report is based on the vision screening protocol in the region of Jinan, which is the capital of eastern China's Shandong province. Jinan has a population of approximately 5.21 million (Statista, 2019).

Vision screening is funded by the hospital; it is not known how vision screening is funded in other areas but the systems vary. The content of the vision screening programme is decided upon by a professional body of ophthalmologists and orthoptists, or a public health organisation.

Vision screening started in 2008 and was implemented in the Purui eye hospital group in 2012. Recently, vision screening archives have been introduced, which is the only known change to the vision screening programme since it began. There are regional general health screening guidelines that provide information on vision screening.

Vision screening is conducted by paediatric ophthalmologists, ophthalmologists and paediatricians. There are approximately 20 vision screening professionals per million population. General professionals that do not screen, but could do so with additional training have been identified as ophthalmologists.

There is specific training to perform vision screening for screening professionals via local screening training and further secondary education each year. This training lasts 3 months and is regularly updated, monitored or revalidated, however, it is not accredited or certified.

The vision screening programme is reviewed every 1-2 years by the local government according to national government policies. There is no specific funding for these revisions. There are methods imposed by the government to quality monitoring of the programme. Information is collected by a local-national screening system. There has been research conducted concerning the vision screening programme, however, there has been no cost-effectiveness analysis.

6.2. Screening programme

In China, retinopathy of prematurity (preterm babies) and reduced visual acuity are the target conditions screened for by vision screening. 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 the sections below.

6.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by a paediatric ophthalmologist in an eye clinic. The tests conducted at this age include retinal examination at 1 month of age.

6.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician or an ophthalmologist in a hospital or a child healthcare centre. The tests conducted include retinal examination at 1 month of age. Babies are referred after 1-2 abnormal tests or 2-3 inconclusive examinations.

6.2.3. Vision screening - 3 months to 36 months

Infants aged 3 to 36 months of age are screened by either a paediatrician or an ophthalmologist in an eye clinic. The tests conducted at this age include eye inspection, eye motility, Hirschberg test, retinal examination, cover test and alternate cover test at 3 months of age, followed by automated screening (Suresight, Topocon) at 6 months of age. Infants are referred after 2 abnormal tests or 2-3 inconclusive examinations.

6.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months to 7 years of age are screened by a paediatrician or an ophthalmologist in an eye clinic. The tests conducted at this age include eye inspection, eye motility, Hirschberg test, retinal examination, pursuit movements, pupillary reflexes, cover test, alternate cover test, visual acuity measurement, stereopsis (Titmus), colour vision (colour test book), autorefraction and automated screening (Suresight, Topocon). Visual acuity is measured for the first time at 3 years of age and then repeated every 6 months until 18 years of age. The optotype chart used for visual acuity measurement is a logarithmic eye chart (logMAR, one space, crowded, with a range of 0.1-2.0 decimal). Referral criteria is defined as:

- 3 years of age: visual acuity of less than 0.6 decimal (0.2 logMAR, 6/9.5 Snellen)
- 4 years of age: visual acuity of less than 0.8 (0.1 logMAR, 6/7.5 Snellen)
- 5 years of age and above: visual acuity of less than 1.0 (0.0 logMAR, 6/6 Snellen)

Children are referred after 1 abnormal tests or 2-3 inconclusive examinations.

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

	Paediatric Ophthalmologist	Ophthalmologist	Paediatrician
Preterm babies	✓	×	×
0 to 3 months	×	✓	✓
3 to 36 months	×	✓	✓
3 to 7 years	×	✓	✓

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

	EI	EM	Hir	RE	PM	PR	CT	AC T	VA	SV	CV	AS	AR
Preterm babies	×	×	×	✓	×	×	×	×	×	×	×	×	×
0 to 3 months	×	×	×	✓	×	×	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	×	×	✓	✓	×	×		✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:

ACT: Alternating Cover Test; AR: Autorefraction; AS: Automated Screening; CT: Cover Test; CV: Colour Vision; EI: Eye Inspection; EM: Eye Motility; Hir: Hirschberg test; PM: Pursuit Movements; PR: Pupillary Reflexes; RE: Retinal Examination; SV: Stereoacuity; VA: Visual Acuity

Table 3: Location of vision screening for each age group

	Eye Clinic	Hospital	Child Healthcare Centre
Preterm babies	✓	×	×
0 to 3 months	×	✓	✓
3 to 36 months	✓	×	×
3 to 7 years	✓	×	×

7. Croatia

Vision screening representative for Croatia: Dr. Mirjana Bjelos, Ophthalmologist, University Eye Clinic, University Hospital Sveti Duh, Faculty of Medicine University in Osijek.

7.1. Vision Screening Commissioning and Guidance

Vision screening in Croatia is organised nationally, with no regional variation between protocols. The vision screening programme is funded by health insurance and is embedded into a general preventative child health care screening system. The content of this programme is decided upon by the Ministry of Health and was implemented nationally in July 2015. There have been no changes since its introduction and therefore, no revisions have been made. However, any revisions would be decided upon by the Ministry of Health and funded through national health insurance.

Ophthalmologists perform vision screening in hospitals and child healthcare centres. There are approximately 400 vision screening professionals per million population. Paediatricians, GPs and nurses have been identified as general health professionals who do not currently screen, but could do so with additional training. There is no specific training available currently.

From June 2015, vision screening of all 4-year-old children performed in ophthalmologists' practices was introduced as a national health policy. Since January 2016, founded on the Bušić, Bjeloš & Kuzmanović Elabjer (2016) ZAPS (Zagreb Amblyopia Preschool Screening Study) study results, vision screening of all 4-year-old children performed in ophthalmologists' practices has become the National Preventive Program of Early Amblyopia Detection. Two-hundred and fifty thousand brochures about amblyopia and preventive program of early amblyopia detection per year are printed and delivered to primary care paediatricians in order to be distributed to the parents of 3-year-old children.

There are methods imposed for quality monitoring of vision screening imposed by the government and this is conducted through the national registry of amblyopia. There has been research concerning the vision screening programme (Bušić, Bjeloš & Kuzmanović Elabjer, 2016), however, there has been no cost-effective analysis conducted.

7.2. Screening programme

The target condition screened for in Croatia are retinopathy of prematurity, congenital eye defects and amblyopia. 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 the sections below.

7.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months, are screened with an eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes. A paediatrician will conduct screening at ages 1, 2 and 3 months, at child healthcare centres. Alternatively, this may be conducted at a hospital by an ophthalmologist depending on the delivery status. For instance, all preterm babies with the delivery status with birth weight range from 1500 to 2000 g and/or gestational age ≤ 35 weeks who received oxygen therapy ≥ 4 hours and all preterm babies with the delivery status ≤ 1500 g and/or gestational age ≤ 32 weeks should be screened by an ophthalmologist, in neonatal units: posterior eye segment examination is performed at the age of 4 to 6 weeks, or 31 to 34 weeks gestational age. The ophthalmologist examines the vascularisation zone of the retina and depending on the results of the examination, follow up examinations are scheduled every week, every 1 to 2 weeks or every 2 to 3 weeks. The ophthalmologist should also examine for any other eye abnormalities.

7.2.2. Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened using an eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes. It is unknown at what specific ages these tests are carried out, but all are carried out before 3 months of age. Vision screening takes place at child healthcare centres and is conducted by either a paediatrician or a GP. Red reflex testing is also conducted at child healthcare centres and the examination is completed at the discretion of the paediatrician. Babies are referred to an ophthalmologist for further examination after either two abnormal or inconclusive test results. A normal result is indicated by a red reflex from both eyes with symmetric responses. No reflex, dark spots in the red reflex, a markedly diminished reflex, the presence of a white reflex, or asymmetry of the reflexes are all indications for referral to an ophthalmologist. The exception to this rule is a transient opacity from mucus in the tear film that is mobile and completely disappears with blinking.

7.2.3. Vision screening - 3 months to 36 months

Babies aged between 3 and 36 months of age are screened at age 12, 24 and 36 months by a paediatrician at child health care centres. Tests utilised include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test and alternating cover test. Children with a positive family history of visual impairments or who present pathological findings are referred to an ophthalmologist.

7.2.4. Vision screening - 36 months to 7 years

Between the ages of 36 months and 7 years, children undergo two visual acuity measurements. These tests are completed at a child health care centre at age 4 years by an ophthalmologist (crowded Lea symbols), and 7 years by a school medicine specialist (different tests, Lea symbols, Snellen, Tumbling E, Landolt C). The linear Lea Symbols test is recommended by the National Preventive Program of Early Amblyopia Detection in Croatia. However, the

country representative states that the screening techniques used by health professionals are not standardised in terms of vision test used, approach to the technique of testing, testing distance, pass criterion for the line, pass cut-off criteria for referral to complete ophthalmological examination, or providers' attentiveness, experience and training.

An abnormal test result is defined as a visual acuity of equal to or worse than 0.1 logMAR for Lea symbols (≥ 0.8 decimal, 6/7.5 Snellen) at 4 years of age. Children are referred for further diagnostic examination after either one abnormal or one inconclusive test result. Children are referred for further examination after one abnormal or inconclusive test result.

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

	Paediatrician	Specialist nurse	Ophthalmologist	GP
Preterm babies	✓	×	✓	×
0 to 3 months	✓	×	×	✓
3 to 36 months	✓	×	×	×
3 to 7 years	×	×	✓	×

Table 3: Location of vision screening for each age group

	Child Healthcare Centre	Hospital	Private clinic	Public place	Other
Preterm babies	✓	✓	×	×	×
0 to 3 months	✓	×	×	×	×
3 to 36 months	✓	×	×	×	×
3 to 7 years	✓	×	×	×	×

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

	EI	Fix	RR	EM	Hirsch	RE	PM	PR	CT	ACT	VA
Preterm babies	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	×
3 to 7 years	×	×	×	×	×	×	×	×	×	×	✓

Key:

EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; Hirsch: Hirschberg test; RE: Retinal examination; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover test; ACT: Alternating cover test; VA: Visual Acuity

8. Cyprus

Vision screening representatives for Cyprus: Ms Maria Theocharides, Optometrist and Orthoptist, Nakis theocharides Opticals, MT Ray Optics Ltd, Ophthalmology practices and Dr Marios Vogazianos, Laboratory Director, Coordinator Neonatal Hearing Screening Program, Centre for Preventive Paediatrics.

8.1. 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.

8.2. 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 the sections below.

8.2.1. 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.

8.2.2. 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.

8.2.3. 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 2 or 3 inconclusive tests are needed for referral.

8.2.4. 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, autorefractometry, 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

	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

** Public sector

Table 3: Location of vision screening for each age group

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

* Private sector

** Public sector

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

	EI	RR	Fix	EM	Hir	RE	PM	PR	CT	ACT	VA	SV	CV	AR	AS
Pret erm babi es	✓	✓	✓	×	×	✓	×	✓	×	×	×	×	×	×	×
0 to 3 mo nths	✓	✓	✓	×	×	×	×	✓	×	×	×	×	×	×	×
3 to 36 mo nths	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	×	✓	×
3 to 7 year s	✓ *	✓*	✓*	✓*	✓*	✓ *	✓*	✓*	✓*	✓*	✓ **	✓*	✓ **	✓*	✓*

* Private sector

** Public 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

9. Czech Republic

Vision screening representative for Czech Republic: Dr Martin Hložánek, Specialist in cataract surgery, Ophthalmology Clinic of Children and Adults of the 2nd Medical Faculty of Charles University and Motol University Hospital, Eye Clinic of the Royal Hospital of Královské Vinohrady.

9.1. Vision Screening Commissioning and Guidance

In the Czech Republic, vision screening is organised nationally with no differences between regions. Vision screening is funded by compulsory national health insurance which 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 screening vision began several decades ago. In 2005, congenital cataract screening for newborns was introduced. There is no protocol for the timing of review of the programme, however when required, any changes are decided upon by the Ministry of Health and funded by the government.

Nurses have been identified as general professionals that do not currently screen in the Czech Republic but could do so with additional training. There is however currently no specific training to perform vision screening, it relies upon training during general study for paediatric general practitioners (GP).

There are no methods for quality monitoring of vision screening imposed by the government, and there has been only degree level research investigating the vision screening programme. There have been no cost-effectiveness or clinical-effectiveness studies of the vision screening programme.

9.2. Screening programme

The target conditions screened for by vision screening are congenital cataract and reduced visual acuity. There is no protocol for vision screening available. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child. Specific details of the screening offered within each age group are described more fully in the sections below.

9.2.1. Vision screening - Preterm babies

Preterm babies are screened by either a paediatrician or an ophthalmologist in a hospital. A retinal examination is performed from 31st to 33rd gestational week or 4th-6th postnatal week, whichever term comes earlier. Subsequently, babies are screened at 2-week intervals, if there are signs of retinopathy of prematurity (ROP) the interval is shorter (1 week). If there are no signs of ROP, screening for ROP finishes at the age of 36th gestational week. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility and retinal

examination (ophthalmologist only). Referral is necessary if there is evidence of ROP, strabismus, loss of fixation, other congenital ocular abnormality or at the parents' request.

9.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened four times by a paediatrician or a nurse in either a hospital or a private clinic. The tests conducted at this age include eye inspection, fixation, red reflex testing and eye motility. Newborns are tested with eye inspection and red reflex at 2 days after release from hospital and with eye inspection, fixation and eye motility at 2 weeks, 6 weeks and 3 months. If a red reflex is not visible, babies are referred to an ophthalmologist.

For other tests, no guidelines are available with regards to referral criteria, therefore, it is at the discretion of the examiner. There are no guidelines concerning the number of inconclusive tests that necessitate referral for further diagnostic examination, this also is at the discretion of the examiner.

9.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by a paediatrician or nurse at the paediatrician's office. The tests conducted in this age group include eye inspection, fixation and eye motility. Automated screening with PlusOptix is sometimes available, but not obligatory. Eye inspection and motility are checked at the age of 4-5 months, 6 months, 8 months, 10-11 months, 12 months, and 18 months. Fixation is checked at the age of 4-5 months, 8 months, 12 months, and 18 months. There are no guidelines on how many abnormal or inconclusive screening results necessitate referral for further diagnostic examination, this is at the examiner's discretion.

9.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened by a paediatrician or a nurse at the office of the paediatrician. The tests conducted at this age include eye inspection, eye motility, visual acuity (VA) measurement, colour vision (Broschmann Dieter, Kuchenbecker Jörn) and automated screening (PlusOptix). Eye inspection, eye motility and VA are tested at the age of 5 and 7 years, knowledge of colours is tested at the age of 5 years, colour vision is tested at the age of 7 years. VA is measured for the first time at 3 years of age. It is measured a second time at 5 years of age and then again at the ages of 7, 11, 13, 15, 17 and 19 years. The optotype charts used include Lea Symbols, HOTV and Tumbling E (Pflüger). There is no standardisation concerning whether these charts are logMAR, linear crowded tests or uncrowded. However, typically a linear crowded, with a testing range from 0.1 – 1.0 (decimal) is used. The examiner decides which test to use and therefore there is no categorical difference between which chart is used at which age. There are no specific guidelines concerning the referral criteria, however in general:

- Worse than 0.5 decimal (0.3 logMAR, 6/12 Snellen) at 3 years

- Worse than 0.63 decimal) (0.2 logMAR, 6/9.5 Snellen) at 5 years
- Worse than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) at 7 years and older (
- Difference between eyes or signs of strabismus at any age

There are no guidelines on how many abnormal or inconclusive screening results necessitate referral for further diagnostic examination, this is at the examiner's discretion.

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

	Paediatrician	Ophthalmologist	Nurse
Preterm babies	✓	✓	×
0 to 3 months	✓	×	✓
3 to 36 months	✓	×	✓
3 to 7 years	✓	×	✓

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

	EI	RR	Fix	EM	RE	VA	CV	AM
Preterm babies	✓	✓	✓	✓	✓	×	×	×
0 to 3 months	✓	✓	✓	✓	×	×	×	×
3 to 36 months	✓	×	✓	✓	×	×	×	✓
3 to 7 years	✓	×	×	✓	×	✓	✓	✓

Key:

EI: Eye inspection; RR: Red reflex testing; Fix: fixation; EM: Eye motility; RE: Retinal examination; VA: Visual Acuity measurement; CV: Colour vision; AM: Automated screening

Table 3: Location of vision screening for each age group

	Hospital	Paediatrician office	Private Clinic
Preterm babies	✓	×	×
0 to 3 months	✓	×	✓
3 to 36 months	×	✓	×
3 to 7 years	×	✓	×

10. Denmark

Vision screening representative for Denmark: Dr Lotte Welinder, Aalborg University Hospital, Department of Ophthalmology.

10.1. Vision Screening Commissioning and Guidance

In Denmark, vision screening is organised nationally, with no regional variation between protocols. Vision screening is embedded into the general preventative child healthcare screening system. The content of this system is decided upon by the Ministry of Health and was commenced and implemented nationally in 1946. The vision screening programme has been changed since its start date, specifically in 1945 vision screening was conducted on children aged 6 years, in 1963 vision screening was also conducted on children aged 4 years and in the most recent revision (2007), vision screening was changed to include children aged 3 years. These revisions are decided upon by the Ministry of Health and are tax-funded.

Under these provisions vision screening is conducted by either a YHN in the child's home, or in school once the child reaches school age, or by the GP at the GP's office. There are approximately 3500 GPs in Denmark, however, doctors devote only 5% of their time to screening, of which, roughly 10% is specific to vision screening. Danish vision screening is conducted with general paediatric screening. This is performed by the GP and the YHN. No other general healthcare professionals see the children regularly. It is possible to add another layer to the screenings, for example, ophthalmic assistants, optometrists and ophthalmologists; however, there are no plans to as the Danish screening system appears to be a cheap and effective method. The training that is undertaken by specialist nurses is practical and embedded within their specialist training, which runs for 1.5 years. GPs do not undertake formalised vision screening training, apart from a course in screening and paediatric examinations, which is undertaken during general training and is comprised of 4 day courses covering screening/ophthalmology/healthy children/sick children; a "pass" is achieved through attending.

The training provided is not regularly updated, monitored, or revalidated. Denmark does not have exam-based training to be a sub-specialist such as a GP. It works with log-books that the doctor fills out during training. Certification is granted as a GP after completing all "logs", this is not recertified later and there is no accreditation for vision testing.

There are no specific methods for quality monitoring for vision screening imposed by the government and information is not systematically collected. The general practitioner (GP) and the Youth Health Nurse (YHN) have separate recordings. The GP keeps individual data in patient records and are not publically available. In most places the YHN's collaborate in the municipality so data is available for all YHNs in the municipality. There have been studies concerning the effectiveness of the vision screening programme in Denmark (Nørregaard et al, 2010; Høeg et al., 2015; Torp-Pedersen et al., 2017). There has been no

cost-effectiveness analysis of this programme, but Nørregaard et al. (2010) provides a cost-benefit analysis compared to the British system.

10.2. Screening programme

Reduced vision, strabismus and amblyopia are target conditions screened for in Denmark. 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 the sections below.

10.2.1. Vision screening - Preterm babies

Preterm babies are seen in hospital for retinal examination if born before 32 weeks or if they weigh below 1500g. No specific vision screening exists, they follow the same vision screening provided to babies born at full term: The YHN makes an appointment 1 week after birth. Within the first 3 months, the child is seen at least 2 times, but if needed this can be more. Testing includes eye inspection, fixation, and observation for manifest strabismus. The GP sees the child at 5 weeks conducting the same tests.

10.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened in the same way as preterm babies, conducted at the home of the parent or private clinics. Well, healthy babies are screened by a nurse at 2 to 3 weeks of age, by a GP at 5 weeks of age and again by a YHN at 8 weeks of age. There are no standardised criteria regarding the number of abnormal or inconclusive test results which necessitate a baby to be referred for further examination, this is individually decided by the YHN or GP.

10.2.3. Vision screening - 3 months to 36 months

Vision screening is conducted by a YHN, at home at 8 months of age and by a GP in clinics at 5 months and 1 year. There are no new tests introduced at this age' the same tests are provided as for preterm or well, healthy babies.

10.2.4. Vision screening - 36 months to 7 years

GPs conduct vision screening at age 2, 3, 4 and 5 years. A YHN performs vision screening in school at ages 6 to 7 years. Retinal examination and visual acuity measurement are performed and these are conducted at the GPs office, in the child's home (YHN) and in local schools (YHN). Visual acuity is measured for the first time at 3 years of age, this is conducted by a GP. This is done using, in the majority of cases using the Osterberg picture chart, which is an old version of the Snellen linear optotype chart; it is not validated or standardised and is said to be used because of tradition and because of a lack of funding for logMAR based tests. The Snellen letters chart is also used in some schools. Visual acuity measurement is repeated at ages 4, 5, 6, and again over the age of 7 years by either a GP or a YHN - with referral criteria of worse than 6/9 Snellen in one or both eyes (0.2 logMAR, 0.63 decimal). The number of abnormal test

results or inconclusive tests necessitating referral for further diagnostic examination is not known.

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

	Youth Health Nurse	GP
Preterm babies	✓	×
0 to 3 months	✓	✓
3 to 36 months	✓	✓
3 to 7 years	✓	✓

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

	Retinal Exam	Eye Inspection	Fixation	Cover test	Visual Acuity
Preterm babies	✓	✓	✓	✓	×
0 to 3 months	✓	✓	✓	✓	×
3 to 36 months	✓	✓	✓	✓	×
3 to 7 years	✓	×	×	×	✓

Table 3: Location of vision screening for each age group

	Hospital	Private clinic	Home	School
Preterm babies	✓	×	×	×
0 to 3 months	×	✓	✓	×
3 to 36 months	×	✓	✓	×
3 to 7 years	×	✓	✓	✓

11. England & Wales

Vision screening representative for England & Wales: Tom Lomas, Joint Head Orthoptist, Lead for Paediatric Orthoptic services, Warrington and Halton Hospital.

11.1. Vision Screening Commissioning and Guidance

In England and Wales, vision screening is organised either nationally or regionally, depending on the type of screening. Premature babies are screened through a service commissioned by local Clinical Commissioning Groups (CCGs). CCGs are clinically led, statutory National Health Service (NHS) bodies responsible for the planning and commissioning of health care services for their local area. There are now 195 CCGs in England. They assess local needs, decide priorities and strategies, and then buy services on behalf of the population from providers such as hospitals, clinics or community health bodies. Screening of all babies is commissioned by a national programme through Public Health England (PHE). This is a standardised programme with a national specification and national monitoring of standards. Screening for reduced vision is organised regionally by each Local Authority (LA), although not all regions provide this recommended vision screening. Mapping of services throughout the UK was completed by the British and Irish Orthoptic Society (BIOS) in 2014, these maps show areas that do not offer visual acuity screening (Appendix 1 – Vision Screening Map B). There have been some changes to these services over the last 4 years but there is no ongoing system in place to record these changes.

Despite UK National Screening Committee (NSC) recommendations for screening to test visual acuity (VA) at age 4 to 5 years being in existence since 2003 (GOV.UK, 2018d), there are differences in vision screening protocols for reduced vision between regions, concerning the professionals who conduct screening, the age screened, the tests used, referral criteria, referral pathways and the funding. Visual acuity screening should be funded by each region's LA. The content of the programme is decided upon by a LA, based on individual service specifications. To address these differences PHE produced national guidance and specifications for visual acuity screening at age 4 to 5 years in November 2017 (described more fully in section 3 below). But as this screening is not mandatory, LAs may not adopt these guidelines. It is too early to evaluate whether this guidance has led, or will, lead to improved standardisation and equity in service provision.

The National Newborn Infant Physical Examination (NIPE), which includes screening of the eyes, was implemented in its current form in 2008. Revisions to the recommendation are made by the NSC and funded by the Government Department of Health. Revisions take place based on published evidence and review by the committee and experts. Quality monitoring is imposed by the government using standards devised by experts for PHE; these were last updated in August 2018 (GOV.UK, 2018b).

For visual acuity screening, it is not known when each of these services was implemented as services vary across the country. The UK NSC first recommended screening for visual acuity at age 4 to 5 years of age in 2003. A review of evidence was carried out in 2013 and the recommendations were reapproved at that stage. A review of evidence and revision to the recommendation by the UK NSC is expected in 2019. Revisions to the recommendation made by the NSC are funded by the Government via the Department of Health. Revisions take place based on published evidence and review by a committee and experts. Currently there are no methods for quality monitoring imposed by the government and quality assurance is dictated by service agreements of the LA with service providers, which are usually hospital orthoptic departments. PHE have commissioned development of standards to advise the LA and to standardise the approach taken to this.

There have been surveys for mapping and collection of outcome data conducted, regarding the screening programmes across the UK, by the British and Irish Orthoptic Society (BIOS) (Griffiths, Carlton and Mazzone, 2017; Griffiths, Carlton and Mazzone, 2018) and private companies investigating automated screening. There has also been a cost-effectiveness analysis (Carlton et al., 2008). Local department audits have been conducted to determine the effectiveness of the vision screening programme in the UK. It is not known how many vision screening professionals there are in the UK per million population. Nurses, Healthcare Assistants and Orthoptic Assistants conduct screening in some areas, no other general healthcare professionals have been identified that do not screen, but could do so with additional training. There is specific training to perform vision screening, this is usually completed by non-eye health professions using an official training package, such as the BIOS training tool. This training can take between 1-4 months to complete, but it is dependent on the individual. Competency assessments, quality assurance and training updates take place annually, however, this training is not accredited or certified; it is agreed ad-hoc by the provider and commissioners of each service and has been adapted to local packages in some case. PHE has commissioned a standardised training package based on the BIOS training. This will be available in 2019.

11.2. Screening programme

The target conditions screened for in England and Wales are:

- Retinopathy of prematurity (ROP)
- Congenital eye disorders at birth - primarily congenital cataracts but also any additional risk factors for eye disease or other incidental findings, for example, aniridia, coloboma and retinoblastoma
- Reduced vision at the age of 4 to 5 years of age, specifically due to amblyopia but may also include uncorrected refractive error

There are evidence-based guidelines for the screening and treatment of ROP. There were developed in 2008 (RCOphth, 2018) by a multidisciplinary guideline development group (GDG) of the Royal College of Paediatrics & Child Health (RCPCH) in collaboration with the Royal College of Ophthalmologists (RCOphth), British Association of Perinatal Medicine

(BAPM) and the premature baby charity BLISS. It provides 25 evidence-based recommendations and 21 good practice points. This guideline has been produced specifically for use within the UK and supersedes a previous guideline.

Vision screening in well health babies is combined with a general screening programme (NIPE) (GOV.UK, 2018c). The UK NSC recommends that all eligible babies should be offered the NIPE screen. The screen is undertaken and completed within 72 hours of birth and then again at 6 to 8 weeks of age. The NHS NIPE Screening Programme aims to reduce morbidity and mortality by:

- identifying and referring all children born with congenital abnormalities of the eyes, heart, hips, and testes, where these are detectable, within 72 hours of birth
- identifying those abnormalities that may become detectable by 6 to 8 weeks of age, at the second physical examination

The UK NSC (2013) continues to recommend vision screening for reduced vision at the age of 4 to 5 years offered by an Orthoptic-led service and provided by Local Authorities as part of the Healthy Child Programme (GOV.UK, 2018a). Public Health England (PHE) produced guidance in 2017 to support Local Authorities in commissioning this recommendation (GOV.UK, 2018d). This guidance includes a service specification, screening competencies for personnel delivering screening, a screening pathway including referral criteria, information leaflets for parents and teachers and letters to invite and inform parents.

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 the sections below.

11.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in a neonatal ward or in the ophthalmology outpatient department of a hospital following the Royal College of Ophthalmologists guidelines (RCOphth, 2018). The tests conducted at this age include eye inspection and retinal examination. The sequence of these tests is:

- Babies born before 27 weeks' gestational age (i.e. up to 26 weeks and 6 days) - the first ROP screening examination should be undertaken at 30 to 31 weeks' postmenstrual age
- Babies born between 27 and 32 weeks' gestational age (i.e. up to 31 weeks and 6 days) - the first ROP screening examination should be undertaken between 4 to 5 weeks (i.e. 28-35 days) postnatal age.
- Babies >32 weeks' gestational age but with birth weight <1501 grams – the first ROP screening examination should be undertaken between 4 to 5 weeks (i.e. 28-35 days) postnatal age.
- Minimum frequencies of screening should be weekly when:
 - the vessels end in zone I or posterior zone II; or
 - there is any plus or pre-plus disease or

- there is any stage 3 disease in any zone.
- Minimum frequencies of screening should be every 2 weeks:
 - In all other circumstances until the criteria for termination have been reached.
- All babies <32 weeks gestational age or birth weight <1501g should have their first ROP screening examination prior to discharge.

11.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician or a specialist nurse in a hospital or at the home of the child. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, pursuit movements and pupillary reflexes. Fundus red reflex examination to diagnose a white pupil is performed only by the paediatrician. The sequence of these tests is:

- Within the first 72 hours from birth: Eye opening, presence of eyes, position and symmetry, size and colour, presence of red reflex.
- Repeated between 6-8 weeks from birth: As above with the addition of eye motility and fixing and following.

Babies are referred after one failed screening tests, however there is no definition as to how many inconclusive tests necessitate referral for further diagnostic examination.

11.2.3. Vision screening - 3 months to 36 months

There is no population-based vision screening recommended by PHE in this age group.

11.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years of age are screened once at age 4 to 5 years. There are no guidelines or recommendations for children in other age groups to receive vision screening.

The screening is delivered by either a school nurse, healthcare assistant, orthoptic assistant or an orthoptist, this varies depending on the area and the contract agreed by the LA.

In most areas the vision screening takes place in schools but rarely it may take place in hospital clinics or community clinics.

The UK PHE recommended test to be conducted at age 4 to 5 years is a visual acuity measurement with the Keeler Crowded logMAR test and this is used in most areas. Some areas use Sheridan Gardiner singles test (Snellen), Kay Pictures (single or crowded depending on cooperation and ability) or Sonksen Silver crowded logMAR test.

The PHE guidance is that any child not achieving 0.2 logMAR on the Keeler Crowded logMAR test should be referred after one screen even if it is suspected to be due to poor cooperation.

In some areas the vision screening offered varies from the UK NSC and PHE recommendation as follows:

Not all areas receive primary vision screening (Appendix 1 - Vision Screening Map A). Some areas commission screening at pre-school aged 3 years (Appendix 1 - Vision Screening Map C). Some areas provide visual acuity and an orthoptic assessment; this includes cover test, ocular movements, convergence, stereotests (Frisby test), prism reflex test (Appendix 1 - Vision Screening Map B) and in rare cases includes automated screening. Some areas have a local arrangement to routinely offer a second screening prior to referral, for those children who fail the test. The number of inconclusive results prior to referral may also differ based on the area.

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

	Ophthalmologist	Orthoptist	Specialist nurse	Doctor	Orthoptic/ Healthcare assistant
Preterm babies	✓	×	×	×	×
0 to 3 months	×	×	×	✓	×
3 to 36 months	×	×	×	×	×
3 to 7 years	×	✓	✓	×	✓

Table 3: Location of vision screening for each age group

Table 3	GP Clinic	Home	Hospital	Child healthcare centre	School
Preterm babies	×	×	✓	×	×
0 to 3 months	✓	✓	✓	✓	×
3 to 36 months	×	×	×	×	×
3 to 7 years	×	×	×	✓	✓

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

	EI	Fix	RR	EM	Hir	RE	PM	PR	CT	VA
Preterm babies	✓	✓	✓	x	x	✓	x	✓	x	x
0 to 3 months	✓	✓	✓	✓	✓	x	✓	✓	✓	x
3 to 36 months	x	x	x	x	x	x	x	x	x	x
3 to 7 years*	x	x	x	x	x	x	x	x	x	✓

* Variable screening conducted by different CCGs and LAs. Information given in the table represents the national PHE guidance. – This also applies to Table 1. Some regions carry out VA and Orthoptic assessment including cover test, ocular motility and stereoacuity.

Key:

EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; Hir: Hirschberg test; RE: Retinal examination; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover test; VA: Visual Acuity measurement

12. Estonia

Vision screening representative for Estonia: Dr Mari Levin, East Tallinn Central Hospital.

12.1. Vision Screening Commissioning and Guidance

Vision screening in Estonia is organised nationally, with no regional variation between protocols. Vision screening is performed by family doctors and family nurses. In some cases, vision screening is performed by ophthalmologists, orthoptists and optometrists in hospitals or private clinics. There are approximately 1700 family doctors and family nurses, per million people. There are family doctors and family nurses that do not screen, but could do so with additional training. Changes to the national vision screening programme are still in progress, the aim is that healthy children will be screened by family doctors and nurses, whereas ophthalmologists, orthoptists and optometrists will not screen healthy children. At present, as the new regulation by the Ministry of Social Affairs is not in force, some family doctors follow old guidelines and do not screen healthy children. Due to the period of transition, there is no exact statistical data. Training for family doctors and nurses is provided by ophthalmologists and orthoptists, this last for around 4 hours. The training is regularly updated, monitored and revalidated, however, this is not yet accredited or certified.

Vision screening is funded through health insurance and it is embedded into a general preventative child healthcare screening programme. The content of the vision screening programme is decided upon by ophthalmologists and was implemented nationally in 1995. Since its application, the vision screening programme has been changed; this change is being fulfilled at present, with the addition of family doctors and family nurses as vision screeners.

The national general health screening guideline provides recommendations for vision screening to each professional. The vision screening programme is reviewed once every 5 years, and any revisions are decided upon by the Ministry of Social Affairs through guideline revisions set out by the Estonian Ophthalmological Society. There are no methods for quality monitoring of vision screening imposed by the government.

There is no research carried out in Estonia regarding the vision screening programme, or the cost-effectiveness and overall effectiveness of the vision screening programme.

12.2. Screening programme

In Estonia, the target conditions for vision screening are retinopathy of prematurity and reduced visual acuity measured at 3 years and again at 6 years of age. 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 the sections below.

12.2.1. Vision screening - Preterm babies

All babies less than 32-weeks gestational age or less than 1500g birthweight are screened for retinopathy of prematurity (ROP). The first ROP screening examination is performed between 4 to 5-weeks postnatal age. The baby is screened until full retinal vascularisation, at least until 40-weeks gestational age. Frequency of follow-up examinations is determined by the examining ophthalmologist on the basis of retinal findings. Babies are screened by binocular indirect ophthalmoscopy and digital retinal images (Retcam). These tests are conducted by a paediatric ophthalmologist at either a children's hospital or an eye clinic and referral for further diagnostic examination is determined by absence of red reflex, or suspicion of eye pathology during eye inspection.

12.2.2. Vision screening - Birth to 3 months

A neonatologist will screen newborns at the maternity hospital, this includes external inspection of the eyes and lids and red reflex examination. Family doctors (GP) will then screen again during 1-2 weeks of life at an outpatient clinic including external inspection of the eyes, lids and red reflex examination. These tests are conducted by either a paediatrician, ophthalmologist or a GP at a hospital. Referral for further diagnostic examination is determined by absence of red reflex, or suspicion of eye pathology during eye inspection. Babies are referred after one abnormal or one inconclusive test and if there is any suspicion of pathology.

12.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by a GP in an outpatient clinic. The GP will perform the eye inspection and red reflex test at 3 months of age and again at 6 months of age, with the addition of fixation, eye motility and Hirschberg. Referral for further diagnostic examination at 6 months of age is determined by abnormal tearing, abnormal fixation and eye motility abnormalities such as nystagmus and strabismus. At 12 months, the GP will conduct assessments using eye inspection, red reflex testing, fixation, eye motility and Hirschberg. Any visible eye pathology, abnormal red reflex, strabismus or tearing results in the child being referred to ophthalmologist.

12.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened using eye inspection, fixation, red reflex testing, eye motility, Hirschberg and a visual acuity measurement. At the age of 3 years, children are screened using a visual acuity assessment for the first time, this is conducted by family nurses using linear crowded Lea Symbols. Visual acuity measurement is repeated at age 6 years, by a family nurse. Vision screening is repeated twice after abnormal or inconclusive test results, or if there is any suspicion of pathology. Children are referred from screening if they fail the visual acuity measurement and this is determined by a visual acuity of 2 lines difference between the eyes (both at ages 3 and 6 years old).

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

	Neonatologist	Nurse	Ophthalmologist	Orthoptist	GP	Paediatrician
Preterm babies	×	×	✓	×	×	×
0 to 3 months	✓	×	✓	×	✓	✓
3 to 36 months	×	×	×	×	✓	×
3 to 7 years	×	✓	×	×	✓	×

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

	EI	Fix	RR	EM	Hir	RE	VA
Preterm babies	✓	×	✓	×	×	✓	×
0 to 3 months	✓	×	✓	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	×
3 to 7 years	✓	✓	✓	✓	✓	×	✓

Key:

EI: Eye inspection; Fix: fixation; RR: Red reflex; EM: Eye motility; Hir: Hirschberg test; RE: Retinal examination; VA: Visual Acuity measurement

Table 3: Location of vision screening for each age group

	Eye Clinic	Hospital	Outpatient clinic
Preterm babies	✓	✓	×
0 to 3 months	×	✓	×
3 to 36 months	×	×	✓
3 to 7 years	×	×	✓

13. Faroe Islands

Vision screening representative for the Faroe Islands: Dr Elin Holm, National Hospital of the Faroe Islands, Landsjúkrahús, Tórshavn.

13.1. Vision Screening Commissioning and Guidance

Vision screening in the Faroe Islands has been implemented for at least forty years. It is organised nationally and is conducted in all areas, with no regional variation. The ministry of health, combined with expert advice from professionals, decide upon the content of the vision screening programme. The vision screening programme is funded by the state and is embedded into the general preventative child healthcare screening system.

Vision screening is conducted by specialist nurses and general practitioners (GP). At present, there are 34 GPs and 31 specialist nurses that perform vision screening for the entire population. All GPs and specialist nurses carry out vision screening and the training is provided within the general training for the respective professions (GP, specialist nurse). There are nurses that do not screen, but could with additional training. Training is regularly updated, monitored and revalidated by the regulations for the health ministry in the Faroe Islands, however, the vision screening training provided is not accredited or certified as it is part of their general education.

Vision screening takes place by the GP at their clinic. The specialist nurse performs vision screening at either the nurse centre, school, kindergarten or the homes of the families. Since its implementation, the vision screening programme has been changed to begin at earlier ages (in infants aged 9 months old), the timing of this change is not documented.

It is unknown how often the vision screening programme is reviewed, but any revisions are decided by expert panels within the health ministry, and are funded by taxes. No methods for quality monitoring of vision screening are imposed by the government and there is no research or cost-effective analysis concerning the vision screening programme.

13.2. Screening programme

The target conditions for preterm and healthy babies up to the age of 3 months are anatomical defects. The target conditions for children aged 3 months to 36 months, are strabismus and any condition affecting visual development. The target condition screened for by GPs and nurses in children aged 3 to 7 years of age is reduced visual acuity. If any child, no matter what age, has strabismus then they are referred for further diagnostic examination. If there is any doubt about the visual acuity of the child, they are referred. Vision screening is not repeated unless the child is not cooperating.

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 the sections below.

13.2.1. Vision screening - Preterm babies

Preterm babies born after 32 weeks with a normal weight are screened by a GP, and preterm babies born under 32 weeks or weighing <1500 grams, are screened at hospital by an ophthalmologist. The screening includes ophthalmoscopy and slitlamp examination. All the other babies are examined by the pediatrician when born. When the babies are ready to go home they continue health screening, including vision screening, by the GP at the GP clinic. Eye inspection, fixation, red reflex testing and pursuit movements are performed on preterm babies up to the age of 3 months old.

13.2.2. Vision screening - Birth to 3 months

The vision screening tests conducted on well, healthy babies up to the age of 3 months include eye inspection, fixation, red reflex testing and pursuit movements. All of which are carried out at the hospital or GP clinic at 5 weeks of age by a GP or specialist nurse, with the exception of red reflex testing which is performed only by the GP. If there are problems with the reflex or anatomy of the eye, the child is referred to an ophthalmologist immediately.

13.2.3. Vision screening - 3 months to 36 months

The vision screening is performed five times between the age of 3 to 36 months; at 5 months, 9 to 10 months, 1 year, 2 years and 3 years of age. At 5 months of age the GP will carry out an eye inspection, fixation, red reflex testing, pursuit movements and Hirschberg test. This is followed by fixation, pursuit movements and Hirschberg test repeated at 9 to 10 months by a specialist nurse. At 1, 2 and 3 years the GP performs an eye inspection, fixation, red reflex testing, pursuit movements and Hirschberg test.

13.2.4. Vision screening - 36 months to 7 years

Vision screening is performed four times within this age group, conducted by the GP at ages 3 to 4 and 4 to 5 years old, and then by a specialist nurse at 6 to 7 and 7 to 8 years old. The eye screening tests used within this age category are listed as Hirschberg, visual acuity, stereopsis (Stereo Fly Test) and colour vision testing.

The visual acuity is tested using a Snellen or E chart (linear, crowded), ranging from 6/60 to 6/3 Snellen (1.0 to -0.3 logMAR, 0.1 to 2.0 decimal). The type of chart used is determined by the professional performing the test, some GPs/specialist nurses have Snellen charts and others have E charts. The directions from the health ministry allow both type of charts to be used. After the age of 7-8 years testing is at variable intervals, ranging from 1 to 3 years between tests.

Children are referred if the test is abnormal or inconclusive. If the vision test is abnormal, the children are referred to the ophthalmologist. If the vision test is inconclusive, the test is repeated within 1 month for children younger than 6 years, and within 1 to 3 months for older children.

All children in this age range are referred if they have a visual acuity of less than 6/9 Snellen (0.2 logMAR, 0.67 decimal) in one or both eyes. All ages are referred if there is evidence of strabismus.

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

	Specialist nurse	Ophthalmologist	GP	Paediatrician
Preterm babies	×	✓	✓	✓
0 to 3 months	✓	×	✓	×
3 to 36 months	✓	×	✓	×
3 to 7 years	✓	×	✓	×

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

	Hospital	GP clinic	Kindergarten	School
Preterm babies	✓	✓	×	×
0 to 3 months	✓	✓	×	×
3 to 36 months	×	✓	×	×
3 to 7 years	×	✓	✓	✓

Table 3: Location of vision screening for each age group

	EI	Fix	RR	Hir	PM	VA	S	CV
Preterm babies	✓	✓	✓	×	✓	×	×	×
0 to 3 months	✓	✓	✓	×	✓	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	×	×
3 to 7 years	×	×	×	✓	×	✓	✓	✓

Key:

EI: Eye inspection; Fix: fixation; RR: Red reflex testing; Hir: Hirschberg test; PM: Pursuit movements; VA: Visual Acuity measurement; S: Stereopsis; CV: Colour vision

14. Finland

Vision screening representative for Finland: Dr Hanna-Mari Jauhonen, Finnish Medicines Agency.

14.1. Vision Screening Commissioning and Guidance

In Finland, there are national guidelines for conducting vision screening, however, it is organised regionally with differences between protocols. Vision screening is embedded into a general preventative child healthcare screening system and funded by each municipality. The National Institute of Health and Welfare develops and recommends the content of vision screening programme. Any revisions to the programme would be made by the National Institute of Health and Welfare in collaboration with a network of specialists, and funded by the government. It is not known when the programme started, or if there have been any changes since its implementation.

There are no methods for quality monitoring imposed by the government and no research of concerning the vision screening programme.

Vision screening is conducted by either an ophthalmologist, general practitioner (GP), youth doctor, or specialist nurse. The number of these professionals employed in vision screening per million population is unknown. There are no other general healthcare professionals that have been identified who could undertake the screening with additional training. There is no specific training provided in order to conduct vision screening. Ophthalmologists are the only professionals that prescribe glasses to children under the age of 8 years. Other treatment options for amblyopia include patching. All eligible children are offered treatment.

14.2. Screening programme

The target conditions screened for by vision screening are retinopathy of prematurity (ROP) and amblyopia. The health care professionals delivering vision screening, venue for screening and tests used, vary depending on the age of the child. Specific details of the screening offered within each age group are described more fully in the sections below.

14.2.1. Vision screening - Preterm babies

Preterm babies, if born under 32 weeks, are screened by an ophthalmologist at a hospital. The tests conducted at this age include eye inspection and retinal examination.

14.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician before discharge, and then by a youth doctor or GP in a child welfare clinic. The tests conducted at this age include eye inspection, red reflex testing, pursuit movements and pupillary reflexes and

presence or absence of eye contact. These tests are all conducted at birth. It is not known how many abnormal or inconclusive test results necessitate referral for further diagnostic examination. Criteria that necessitate referral include presence of abnormal eye structures, dark red reflex, or no eye contact.

14.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened twelve times by a specialist nurse and four times by a GP in a child welfare clinic. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, cover test, Hirschberg test and pursuit movements. These tests are conducted at 4, 8 and 18 months. Criteria that necessitate referral include presence of abnormal eye structures, dark red reflex, or no eye contact. Infants are referred for further diagnostic examination after one abnormal or two inconclusive test results.

14.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years of age are screened by a specialist nurse or a GP in a child welfare clinic. This is part of routine visual screening conducted as a part of child welfare clinic visit. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movement, pupillary reflexes, cover test, alternating cover test and visual acuity measurement. The age of screening and tests at each age are as follows:

- 3 years: Eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, near visual acuity measurement.
- 4 years: near and distance visual acuity, Hirschberg test, cover test, alternating cover test. This is repeated at the age of 5 years and 6 years.
- 7 years: near and distance visual acuity. This is repeated at 11 years and 14 years of age.

The optotype charts used for children aged 3 to 6 years include linear Lea Symbols based on the Snellen format (Snellen 6/126 to 6/3, logMAR 1.3 to -0.3, decimal 0.05 to 2.0) and a Snellen number chart at age 7 years and older. Children are referred for further diagnostic examination after one abnormal or two inconclusive test results

The referral criteria are as follows:

- 3 to 4 years: strabismus, visual acuity under 0.5 decimal (6/12 Snellen, 0.3 logMAR) or 2 lines difference in visual acuity, absent red reflex, abnormal head posture.
- 5 to 6 years: strabismus, visual acuity under 0.63 decimal (6/9.5 Snellen, 0.2 logMAR) or 2 lines difference in visual acuity, absent red reflex, abnormal head posture.
- 7 years or older: distance visual acuity under 0.8 decimal (6/7.5 Snellen, 0.1 logMAR), near visual acuity under 0.63 decimal (6/9.5 Snellen, 0.2 logMAR), or any symptomatic eye disorder

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

	Paediatrician	Ophthalmologist	Specialist Nurse	Youth Doctor	GP
Preterm babies	×	✓	×	×	×
0 to 3 months	✓	×	×	✓	✓
3 to 36 months	×	×	✓	×	✓
3 to 7 years	×	×	✓	×	✓

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

	EI	Fix	RR	EM	Hir	RE	PM	PR	VA	CT	ACT
Preterm babies	✓	×	×	×	×	✓	×	×	×	×	×
0 to 3 months	✓	×	✓	×	×	×	✓	✓	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	✓	×	×	✓	×
3 to 7 years	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg; RE: Retinal Exam; PM: Pursuit Movements; PR: Pupillary Reflexes; VA: Visual Acuity; CT: Cover Test; ACT: Alternating cover test

Table 3: Location of vision screening for each age group

	Hospital	Child Welfare Clinic
Preterm babies	✓	×
0 to 3 months	×	✓
3 to 36 months	×	✓
3 to 7 years	×	✓

15. France

Vision screening representative for France: Prof Dominique Bremond-Gignac, Head of Ophthalmology, Hôpital Universitaire Necker, Service d'Ophtalmologie Enfants et Adultes.

15.1. Vision Screening Commissioning and Guidance

Vision screening is organised both nationally and regionally, with 4600 PMI (Protection Maternelle et Infantile (Maternal and child protection centres)). The maternal and child protection centres (PMI) are public health services where parents can go during the pregnancy and until the child is 6 years of age, to receive advice and medical care. All regions provide vision screening and there are no differences in protocols between regions. The national general health screening guideline is used to inform vision screening in France.

Vision screening is funded by health insurance, the council, municipalities, the state, provinces and regions. There are no differences in funding methods between regions and all vision screening is embedded into a general preventative child health care screening programme.

The content of this vision screening programme is determined by the French Public Agency HAS and the French Health Ministry. It is not known exactly when the vision screening programme was initiated, but it has been implemented for a long time. It has been changed since its application. In 2006 the version of the health book (Carnet de Santé) provided more detail for vision screening. In April 2018, the latest version of the health book (Carnet de Santé), made some recommendations including: "Before three years, avoid putting your child in a room where the television is lit, even if he does not look at it " and "Do not give him a tablet or smartphone to calm him, during his meals, or before his sleep".

Vision screening is conducted by ophthalmologists, orthoptists, paediatricians, general physicians (GP) and nurses in hospitals, child health care centres, kindergarten, public places and schools. It is unknown how many vision screening professionals there are in France per million population. Nurses and opticians do not screen, but are general professionals that could screen with additional training. Currently, only orthoptists receive specific accredited training for vision screening. There is no other training for vision screening available.

There is no regularity regarding how often vision screening is reviewed, any revisions are decided upon by the French Public Agency HAS and the French Health Ministry. Funding for review comes from the French Public Agency HAS and free expert input. There are no methods for quality monitoring of vision screening imposed by the government, however, information is collected by the National Institute of Demographic Studies (Institut National d'Etudes Démographiques – INED). It is a French public institution specialised in demographic research and population studies. No vision screening research has been conducted in France and there has been no cost-effective analysis of the vision screening programme.

15.2. Screening programme

The target conditions screened for include any structural abnormality, pathology, strabismus, and reduced visual acuity. 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 the sections below.

15.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by paediatricians, GPs, orthoptists or ophthalmologists in hospitals, private practice and PMI centres. This is completed using a battery of tests including eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes. It is unknown after how many abnormal or inconclusive test results a baby is referred for further examination.

15.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by paediatricians, ophthalmologists or orthoptists in hospitals, child health care centres and private clinics. This is completed by eye inspection, fixation, red reflex testing (ophthalmologist), eye motility, Hirschberg test, pursuit movements and pupillary reflexes. Tests are performed at birth and then again at 2 months. A child is referred after one abnormal result and screening is repeated at the next examination if the screening is inconclusive. The referral criteria for this age category is not defined as it is at the discretion of the examiner.

15.2.3. Vision screening - 3 months to 36 months

At age 3 to 36 months, vision screening is conducted by either a paediatrician, nurse, specialist, nurse, ophthalmologist, orthoptist or GP. This takes place in hospitals, PMI or private practices using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity (VA), stereopsis (Lang) and colour vision. Children are tested at 4 months, 9 months and 24 months.

A VA measurement is conducted by either a nurse, orthoptist, ophthalmologist, GP or paediatrician, for the first time at 24 months, using HOTV or Numbers. The specific charts used include Numbers, CADET Tests, or STYCAR. It is unknown after how many abnormal or inconclusive test results a child is referred for further examination. The referral criteria for this age category is not defined as this is at the discretion of the examiner, but this is usually in the event of any abnormality.

15.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened by either a paediatrician, nurse, specialist

nurse, ophthalmologist, orthoptist, or a GP. This takes place at schools, hospitals, PMI and private practices using eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test, VA measurement, stereopsis (Lang), colour vision and automated screening (PlusOptix, Spot Vision Screener, 2Win). A VA measurement is conducted by either a nurse, orthoptist, ophthalmologist, GP or paediatrician, for the second time at 3 years of age and then a third time at 4 years of age, using HOTV, or Numbers. The specific charts used include:

- Ophthalmologists: Monoyer Test, Numbers, E letters, Pigassou test, CADET Tests
- Orthoptists: Numbers, E letters, CADET Tests or STYCAR
- GPs: CADET Tests or STYCAR

It is unknown after how many abnormal or inconclusive test results a child is referred for further examination as this is at the discretion of the examiner.

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

	Paediatrician	Nurse	Specialist nurse	Ophthalmologist	Orthoptist	GP
Preterm babies	✓	×	×	✓	✓	✓
0 to 3 months	✓	×	×	✓	✓	×
3 to 36 months	✓	✓	✓	✓	✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓

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

	EI	Fix	RR	E M	Hir	RE	P M	PR	CT	AC T	VA	SV	CV	AS
Preterm babies	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	×	✓	✓	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	×
3 to 7 years	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓

Key:

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

Table 3: Location of vision screening for each age group

	Child Health Care Centre	Hospital	Private practice	PMI	School
Preterm babies	×	✓	✓	✓	×
0 to 3 months	✓	✓	✓	×	×
3 to 36 months	×	✓	✓	✓	×
3 to 7 years	×	✓	✓	✓	✓

16. Germany

Vision screening representative for Germany: Dr Heike Elflein, Ophthalmologist, University Medical Centre, Johannes Gutenberg University Mainz, Germany.

16.1. Vision Screening Commissioning and Guidance

In Germany, vision screening is embedded into a general preventative child healthcare screening system and is organised nationally, with no regional variation in vision screening. There are however, regional differences between paediatricians in relation to amblyopia screening (refraction measurement) for children aged up to 2 years. These differences depend on the type of health insurance individuals have; some reimburse the cost of screening, some do not. Some insurance covers a refraction examination at age 2 to 3 years. Approximately 10% of the general population of Germany have some form of private health insurance. Refraction screening is offered by some statutory and some private health insurances. In all regions of Germany vision screening is funded by the state for general health screening, but parents can opt to pay for additional screening, or if they are covered by private health insurance, they can attend vision screening through this. For example, refraction measurement is not part of the general vision screening in Germany, which is funded by the state (statutory and private health insurances have to pay for the general vision screening).

The vision screening programme started in the 1970s and the content was decided upon by the national government. The vision screening programme was changed in July 2008, whereby a visual acuity test was added as part of the general child healthcare examinations at the age of 3 years. There is no clear process in place to determine how often and the procedure adopted for revisions to the vision screening programme.

There are national general health screening guidelines, but no specific vision screening guidelines are available. There are no methods for quality monitoring imposed by the government. There has been research concerning vision screening in Germany, as part of health service research. Studies have been conducted to evaluate the outcome of vision screening; some of these studies are discussed in sections 6 of this report. Cost-effectiveness has been investigated by Gandjour et al (2003) which suggested that in Germany, both from a cost-effectiveness and clinical-effectiveness point of view, screening all children, up to the age of 1 year, for amblyopia and amylogenic factors, should be conducted by an ophthalmologist. However, the full text research article is not accessible, therefore all cost information in section 9 has been provided by the country representative.

Vision screening is conducted by paediatricians, medical assistants and nurses. Vision screening at the school entry examination is conducted by medical assistants, of which there are approximately 780 per million overall population. There are 179 paediatricians per million population and 12 physicians, however, this is overall and they are not just employed for vision

screening. Nurses and practice assistants perform most screening, as delegated by the paediatrician. There is no specific training to perform vision screening.

16.2. Screening programme

The target conditions screened for by vision screening are retinopathy of prematurity (ROP), congenital eye disorders and reduced visual acuity. 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 the sections below.

16.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by either an ophthalmologist or paediatrician in a hospital (during their hospital stay) and then at a private practice. The tests conducted at this age include eye inspection, red reflex testing and retinal examination. Preterm babies below 1500g and below 32 weeks of gestational age receive a retinal examination every two weeks (if nothing is found), until they reach normal birth term, in addition to this, they receive eye inspection and red reflex tests at days 3 to 10 and weeks 4 to 5.

16.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician in private practice. The tests conducted at this age include eye inspection and red reflex testing. These tests are conducted at 3 to 10 days and 3 months (eye inspection) and 4 weeks to 3 months (red reflex test). Babies are referred to an ophthalmologist for further diagnostic examination after the first abnormal test, there is no protocol for how many inconclusive tests determine referral for further examination.

16.2.3. Vision screening - 3 months to 36 months

Infants aged 3 to 36 months of age are screened by a paediatrician in private practice. The tests conducted at this age are eye inspection, fixation, red reflex testing, pursuit movements and pupillary reflexes and autorefractometry (Rodenstock Vision Tester-R11 or R2). The tests performed at each age are:

- 3 to 4 months of age - eye inspection, red reflex testing and fixation
- 6 months - eye inspection, red reflex testing, fixation, pursuit movements
- 1 year - eye inspection, red reflex testing, fixation, pursuit movements, pupillary reflexes
- 2 years - eye inspection, red reflex testing, pupillary reflexes

If a child is on private health coverage and in some health insurances, automated screening (PlusOptix) can be conducted at age 1 year and 3 years. One abnormal test determines referral to an ophthalmologist for further examination.

16.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened by a paediatrician in private practice. The tests conducted at this age include eye inspection, Hirschberg test, pupillary reflexes, visual acuity measurement and stereopsis (Lang Test). Tests are conducted at 4 years of age, 5 years of age and by a nurse under the guidance of a paediatrician before entering school at 6 years of age. Visual acuity is measured at all ages by a paediatrician or the medical assistant under supervision of the paediatrician. The Löhlein chart is the most commonly used chart, although there are no specific guidelines detailing the use of this. The Löhlein chart is based on the Snellen principle, but optotypes are presented. The optotypes sizes and visual acuity ranges from 0.2 to 1.0 decimal (0.7 to 0.0 logMAR, 6/30 to 6/6 Snellen). There are no formal defined referral criteria per age category. One abnormal test determines referral to an ophthalmologist for further examination.

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

	Ophthalmologist	Paediatrician	Medical Assistant <i>Under supervision of paediatrician</i>	Nurse <i>Under supervision of paediatrician</i>
Preterm babies	✓	✓	×	×
0 to 3 months	×	✓	×	×
3 to 36 months	×	✓	×	×
3 to 7 years	×	✓	✓	✓

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

	EI	Fix	RR	RE	Hir	PM	PR	VA	SV	AR	AS *
Preterm babies	✓	×	✓	✓	×	×	×	×	×	×	×
0 to 3 months	✓	×	✓	×	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	×	×	✓	✓	×	×	✓	✓
3 to 7 years	✓	×	×	×	✓	×	✓	✓	✓	×	✓

* With health insurance

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; Hir: Hirschberg; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; VA: Visual Acuity Measurement; SV: Stereopsis; AR: Autorefraction; AS: Automated Screening

Table 3: Location of vision screening for each age group

	Hospital	Private Practice
Preterm babies	✓	✓
0 to 3 months	×	✓
3 to 36 months	×	✓
3 to 7 years	×	✓

17. Greece

Vision screening representatives for Greece: Prof Vasiliki Papaevangelou, National and Kapodistrian University of Athens and Ass Prof Asimina Mataftsi, Aristotle University of Thessaloniki and Dr Achilleas Attilakos, Attikon University Hospital.

17.1. Vision Screening Commissioning and Guidance

Vision screening in Greece is organised nationally, however, there is no specific programme, only guidelines that have been available since 2015. These guidelines were released by the Institute of Child Health, but were only accepted as national guidelines in 2018. Vision screening is not embedded into a general preventative child healthcare screening system. There are no regional differences. To date (October 2018) there have been no revisions of the guidelines.

Vision screening is free in public hospitals and primary care units, however, parents can opt to pay for screening in private practices. Vision screening is delivered by ophthalmologists, some paediatricians and general practitioners (GP) in public hospitals, primary care units and private practices. It is not known how many vision screening professionals there are per million population, but there are many more paediatricians and GPs that could perform vision screening. Nurses in primary care, practice assistants and nursery teachers have been identified as professionals that who do not currently screen, but could do so with additional training. Currently, there is no specific training for vision screeners available. There are no methods for quality monitoring imposed by the government and there has been no research carried out concerning vision screening in Greece.

17.2. Screening programme

The target conditions screened for are retinopathy of prematurity, congenital eye disorders, reduced visual acuity and amblyopia. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child. Specific details of the screening offered within each age group are described more fully in the sections below.

17.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in either a hospital or a private clinic. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes.

17.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician or an ophthalmologist in a child healthcare centre, primary care unit or private clinic. Babies are screened three times: at birth, at 1 to 2 weeks and at 2 months of age. Parents choose the paediatrician or venue. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes. Babies are referred for further diagnostic examination after one abnormal test result. Decisions about repeat screening or referral for diagnostic testing in those with inconclusive results or poor cooperation is at the discretion of the doctor.

17.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by either a paediatrician or an ophthalmologist in hospital, private clinic or primary care unit. Parents choose the paediatrician and venue. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements, pupillary reflexes, cover test, alternating cover test and colour vision. Children are referred for further diagnostic examination after one abnormal test result. Decisions about repeat screening or referral for diagnostic testing in those with inconclusive results or poor cooperation is at the discretion of the doctor.

17.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened by either a paediatrician or an ophthalmologist and sometimes a GP in a hospital, primary care unit or private clinic. Parents choose the paediatrician and venue. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements, pupillary reflexes, cover test, alternating cover test, colour vision and visual acuity measurement. Only paediatric ophthalmologists, and very rarely general ophthalmologists will test visual acuity in 3.5 year-olds. A full eye examination will be performed at the same time in an ophthalmology clinic. No acuity testing is regularly performed elsewhere. Children are referred for further diagnostic examination after one abnormal test result. Decisions about repeat screening or referral for diagnostic testing in those with inconclusive results or poor cooperation is at the discretion of the doctor.

In children above 3.5 years of age only a paediatric ophthalmologist will perform retinal examination and automated screening. Referral is necessary if they fail to pass the visual acuity screening or in the presence of abnormal examination (red reflex, motility, reflexes, cover test).

Visual acuity is measured for the first time between 3.5 and 5 years of age using Lea Symbols, or HOTV. Vision screening is repeated between the ages of 5 to 6 years and then again at 7 to 8 years, 9 years, 11 to 12 years, 14 to 15 years and 17 to 18 years using ETDRS, Snellen, Sloan, Lea Symbols or HOTV. Referral criteria:

- <0.2 LogMAR in one or both eyes ($<6/9.5$ Snellen, 0.63 decimal)
- 2 lines difference between the 2 eyes

- Inability of the examiner to evaluate visual acuity.

Visual acuity assessment is usually performed by general ophthalmologists, the majority of which use decimal non-log-scaled non-crowded visual acuity charts. A large proportion of paediatric ophthalmologists also use decimal non-log-scaled non-crowded visual acuity charts.

The recommendations published in 2015 recommend logMAR testing (crowded or uncrowded-), but ophthalmologists do not always follow these recommendations. Only LEA symbols or HOTV are recommended for visual screening in children 3.5 to 5 years old. ETDRS, Snellen, Sloan, LEA numbers or HOTV are recommended for VA testing, in older children. The test used depends on clinician's choice and the child's age.

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

	Paediatrician	Ophthalmologist	GP
Preterm babies	✓	✓	×
0 to 3 months	✓	✓	×
3 to 36 months	✓	✓	×
3 to 7 years	✓	✓	✓

Table 3: Location of vision screening for each age group

	Hospital	Child Healthcare Centre	Primary Care Unit	Private Clinic
Preterm babies	✓	×	×	✓
0 to 3 months	×	✓	✓	✓
3 to 36 months	✓	×	✓	✓
3 to 7 years	✓	×	✓	✓

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

	EI	Fix	RR	EM	Hir	RE	PM	PR	CT	ACT	CV	VA
Preterm babies	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×
3 to 7 years	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:

EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; Hir: Hirschberg; RE: Retinal examination; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover test; ACT: Alternating cover test; CV: Colour vision; VA: Visual acuity measurement

18. Hungary

Vision screening representatives for Hungary: Dr Szilvia Berkes, Ophthalmologist, University of Szeged, Faculty of Medicine, Department of Ophthalmology and Dr Anna Soproni, Ophthalmologist, Private Medical Office, Budapest.

18.1. 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, autorefractometry 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.

18.2. 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 the sections below.

18.2.1. 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

18.2.2. 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.

18.2.3. 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.

18.2.4. 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

	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

	EI	Fix	RR	E M	Hi r	RE	PR	CT	AC T	VA	SV	CV	AR	AS
Preterm babies	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	×	✓	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓*	✓*
3 to 7 years	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓*	✓*

* 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

	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	×	×	✓	✓*	✓*	✓	✓*
3 to 7 years	×	×	✓	✓*	✓*	✓	✓*

* Optional

19. Iceland

Vision screening representative for Iceland: Dr Elinborg Guðmundsdóttir, Paediatric Ophthalmologist, University of Iceland.

19.1. Vision Screening Commissioning and Guidance

In Iceland, there are national guidelines for conducting vision screening. Vision screening is funded by the state and is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by ophthalmologists and the Public Health Organisation. The vision screening programme began in 1974. Between the years of 1999 and 2009, visual acuity was tested at 3.5 years and 5 years by nurses in primary healthcare centres, but since 2009 visual acuity testing has commenced in children at 4 years old; instead of at 3.5 years and again at 5 years of age. Vision screening is organised nationally, with no regional variation between protocols.

The procedures for vision screening can be found in the national general health screening guidelines. The Directorate of Health regularly updates the guidelines for general screening in children, including vision screening. Updates were completed in 1996, 2009, 2010, 2013 and the last update was in 2016. Regarding the vision screening, recommendations are made by ophthalmologists. The programme has not changed since 2009. There are no methods for quality monitoring of vision screening imposed by the government.

Vision screening is performed by paediatricians, general practitioners (GP) and nurses. It is not known how many vision screening professionals there are per million people. No general professionals have been identified that do not screen, but could do so with additional training. There are specific guidelines in place for nurses, paediatricians and GPs to follow concerning vision screening. It is not known if there is any specific training to perform vision screening.

There has been no cost-effectiveness analysis of the vision screening programme and there have been no other studies on the effectiveness of the vision screening programme in Iceland.

19.2. Screening programme

The target conditions screened for by vision screening are retinopathy of prematurity (ROP), congenital cataract, amblyopia, reduced visual acuity, refractive error, colour vision defects, 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 the sections below.

19.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in a hospital. The vision screening tests conducted are designed to detect retinopathy of prematurity (ROP). There

are no guidelines concerning the number of repeated screens before referral, this is at the discretion of the screener.

19.2.2. Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by either a nurse, paediatrician or a GP in a primary healthcare centre. The vision screening tests conducted include eye inspection, fixation, red reflex testing, cover test, alternating cover test and eye motility. It is only the paediatrician who performs fundus red reflex examination to diagnose a white pupil, the rest of the tests are performed by both paediatrician or a nurse. The sequence of eye screening tests are:

- 5 days old: Paediatrician – eye inspection, red reflex testing
- 6 weeks old: Nurse and paediatrician or GP - eye inspection, red reflex test, fixation, cover test, alternating cover test and eye motility
- 9 weeks old: Nurse - eye inspection, red reflex test, fixation, cover test, alternating cover test and eye motility

There are no defined guidelines on how many abnormal and how many inconclusive tests necessitate referral for further diagnostic examination.

19.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by either a paediatrician, GP, or a nurse in primary health care centre.

The tests conducted include eye inspection, fixation, red reflex testing, cover test, alternating cover test and eye motility; this is recommended at every visit. The sequence of vision screening are:

- 3 months old: Nurse and paediatrician or GP.
- 5 months old: Nurse
- 6 months old: Nurse
- 8 months old: Nurse
- 10 months old: Nurse and paediatrician or GP
- 12 months old: Nurse
- 18 months old: Nurse and paediatrician or GP
- 2.5 years old: Nurse

19.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened by a nurse in a primary healthcare centre or schools. The tests conducted include eye inspection, fixation, eye motility, cover test, alternating cover test, visual acuity measurement and stereopsis (Titmus or Lang). The visual acuity measurement and stereopsis are both conducted from 4 years of age. The same optotype charts are used and all visual acuity measurements are conducted by nurses.

The optotype charts used for visual acuity measurement include Lea symbols (logMAR) and HOTV (Crowded linear test): referral criteria are visual acuity of less than 0.8 decimal (0.3 logMAR, 6/12 Snellen). Visual acuity is measured again at school age (6 years) with referral criteria of less than 1.0 decimal (0.00 logMAR, 6/6 Snellen), and again at 9, 12 and 14 years of age (referral criteria of less than 1.0 decimal (0.00 logMAR, 6/6 Snellen).

Referral for further diagnostic examination is necessitated after one abnormal test result. It is not known how many inconclusive test results determine the need for referral for further diagnostic examination.

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

	Paediatrician	Nurse	Ophthalmologist	GP
Preterm babies	×	×	✓	×
0 to 3 months	✓	✓	×	✓
3 to 36 months	✓	✓	×	✓
3 to 7 years	×	✓	×	×

Table 3: Location of vision screening for each age group.

	Primary Healthcare Centre	Hospital	School
Preterm babies	×	✓	×
0 to 3 months	✓	×	×
3 to 36 months	✓	×	×
3 to 7 years	✓	×	✓

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

	ROP	EI	Fix	RR	EM	CT	ACT	VA	SV
Preterm babies	✓	×	×	×	×	×	×	×	×
0 to 3 months	×	✓	✓	✓	✓	✓	✓	×	×
3 to 36 months	×	✓	✓	✓	✓	✓	✓	×	×
3 to 7 years	×	✓	✓	×	✓	✓	✓	✓	✓

Key:

ROP: Retinopathy of prematurity; EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; CT: Cover test; ACT: Alternating cover test; VA: Visual acuity measurement; Stereopsis

20. India

Vision screening representative for India: Dr Zia Chaudhuri, Paediatric Ophthalmologist, Strabismologist, Neuro-Ophthalmology, Lady Hardinge Medical College, University of Delhi, PGIMER, Dr RML Hospital, New Delhi, India.

20.1. Vision Screening Commissioning and Guidance

Vision screening in India is organised both nationally and regionally. Each community health centre provides services to approximately 30,000 people. All regions should provide vision screening, but some may not for logistical reasons; the national programme policy is not always followed due to local variations in infrastructure. Specifically, the distribution of vision screening in India varies. Vision screening is not currently implemented as part of National Health Policy, therefore there are no set guidelines on this. Depending on the institution providing care and the expertise therein, vision screening varies in different regions in the country. It is true that in most cases vision assessment is performed only after the patient presents to an eye care centre with symptoms.

Vision screening is funded by parents, charity, companies, health insurance, councils, municipalities, parent's employers, states, provinces/regions, and the Government of India National Programme of Control of Blindness (set up in 1976). In government funded tertiary care eye institutions, the charges are usually completely paid for by the government, while in private institutions, it is paid for by the parents directly or by third party insurance. Vision screening is embedded into a general preventative child healthcare screening system, the content of which is decided upon by Technical Committees in the Government of India. The vision screening programme commenced in 1976, this was simultaneously introduced across the whole of India.

The vision screening programme has been changed since its implementation; specifically, in 2003, India adopted the goals of VISION 2020. This is a global initiative that aims to eliminate avoidable blindness by the year 2020. VISION 2020 provides guidance, technical and resource support to countries that have formally adopted its agenda. The guidelines for vision screening are set out in the National General Health screening guidelines, which have been continuously reviewed since 2003. Any revisions are decided upon by the Technical Committee of the Government of India and funded dependent upon need, with budgetary allocation made every year. Revisions are documented and submitted to the committee who decide on the need.

It is not known how many vision screening professionals there are, per million population, in India. There are general professionals that do not screen, but could do so with additional training, including ophthalmologists, neonatologists, optometrists, paediatricians and trained health workers. However, there is currently no specific training to perform vision screening.

There are methods of quality monitoring for vision screening imposed by the government, this is conducted through service and performance audits. However, any research conducted using

this data is institutional and not available to view. There has been no cost-effectiveness analysis and no other studies on the effectiveness of the vision screening programme in India.

20.2. Screening programme

In India, retinopathy of prematurity (ROP) and reduced visual acuity are the target conditions screened for by vision screening. 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 the sections below.

20.2.1. Vision screening - Preterm babies

Preterm babies are screened by a paediatric ophthalmologist in an ophthalmic clinic. The number of screens in this age group is not defined. The tests used include eye inspection, fixation, red reflex testing by 6 weeks of age, eye motility, Hirschberg, retinal examination, pursuit movements and pupillary reflexes by 3 months of age. ROP screening is now a must in all high-risk populations. However, not all children receive this and there is no standardised referral criteria.

20.2.2. Vision screening - Birth to 3 months

Well, healthy babies are screened by either a paediatrician, ophthalmologist, orthoptist or youth doctor in either a hospital, child healthcare centre or a private clinic. The number of screens in this age group is not defined. The tests conducted at this age include eye inspection, fixation and red reflex testing by 6 weeks of age, followed by eye motility, Hirschberg, retinal examination, pursuit movements and pupillary reflexes by 3 months of age. The ophthalmologist or orthoptist is responsible for all vision screening; the paediatrician or youth doctor will only perform a fundus red reflex examination to diagnose a white pupil. Referral for further examination is necessary after 3 inconclusive tests or 3 abnormal test results – however, it is not stated what the referral criteria are at this age.

20.2.3. Vision screening - 3 months to 36 months

Children aged between 3 and 36 months of age are screened by either a paediatric ophthalmologist, optometrist, or an orthoptist in hospital clinics. The number of screens in this age group is not defined. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg, retinal examination, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis, colour vision and autorefractometry. Subsequently, an assessment of visual acuity, stereopsis, ocular motility and alignment, colour vision and refraction (retinoscopy) are conducted by 3 years of age. All tests done by paediatric ophthalmologist, optometrist, or orthoptist. Optometrists and orthoptists conduct the refraction, ocular motility and misalignment evaluation, the paediatric ophthalmologist will overview all findings. Referral for further examination is necessary after

3 inconclusive tests or 3 abnormal test results; however, it is not stated what the referral criteria are at this age. There is no standardised referral criteria.

Visual acuity is measured for the first time at 1-year of age, this is repeated at 2-years of age and then in one year intervals. There is no specific age when this is stopped. Visual acuity is measured by ophthalmologists, optometrists and orthoptists. The same optotype charts are used by each professional at all ages as follows: Grating acuity (Lea symbols) in very young or developmentally delayed children; Alphabets (Sloan letters) and HOTV charts in older children. These charts are logMAR based, not crowded, with a range of 0.05-2.0 decimal and 6/12 (Snellen).

20.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months to 7 years are screened by an ophthalmologist, orthoptist, or optometrist in a hospital clinic. The number of screens in this age group is not defined. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg, retinal examination, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis, colour vision and auto-refraction. Optometrists and orthoptists conduct the refraction, ocular motility and misalignment evaluation, the paediatric ophthalmologist will overview all findings. Referral for further examination is necessary after 3 inconclusive tests or 3 abnormal test results. However, there are no specific guidelines on referral. It is not clear when the visual acuity measurement is conducted between the age of 36 months and 7 years, but usually, at the age of 5 years there is a school vision test with a recommended follow-up every year; however, there are no guidelines on this. This screening is conducted by either school health workers, optometrists, or ophthalmologists who are sent for school vision screening, or trained teachers who are taught to evaluate Snellen's charts. Visual acuity is measured by ophthalmologists, optometrists and orthoptists. The same optotype charts are used by each professional at all ages; this includes: Grating acuity (Lea symbols) in developmentally delayed children; Alphabets and HOTV charts in older children. These charts are logMAR, not crowded, with a range of 0.05-2.0 decimal. Referral criteria is not defined, but the cut off at each age is a visual acuity of 6/12 Snellen (0.3logMAR).

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

	Paediatric ian	Ophthalm ologist	Orthoptis t	Optometr ist	Youth Doctor	Teacher
Preterm babies	×	✓	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	×
3 to 36 months	✓	✓	✓	×	×	×
3 to 7 years	✓	✓	✓	×	×	✓

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

	EI	RR	Fix	E M	Hir	RE	P M	PR	CT	AC T	AR	VA	SV	CV
Preterm babies	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3: Location of vision screening for each age group

	Ophthalmic Clinic	Hospital	Child Healthcare Centre	Private Clinic	School
Preterm babies	✓	×	×	×	×
0 to 3 months	×	✓	×	×	×
3 to 36 months	×	✓	×	×	×
3 to 7 years	×	✓	×	×	✓

21. Ireland

Vision screening representative for Ireland: Ms Alex Doherty, Senior Orthoptist, Community Eye Clinic, Grangegorm Primary Care Centre.

21.1. Vision Screening Commissioning and Guidance

In the Republic of Ireland, vision screening is organised regionally, specifically into nine community health organisations (CHO), all of which provide the same protocol for state – funded vision screening. Vision screening is embedded into a general preventative child healthcare screening system, the content of which is decided upon by the Health Service Executive (HSE). The vision screening programme began in the 1970’s, however, it is not known when it was implemented nationally.

There are national general health screening guidelines available for vision screening, but there is no specified procedure in place for review of the programme. Any revisions would be made by the HSE and funded by the Department of Health and Children through an Eye Services Review Group; this includes ophthalmologists, orthoptists, primary care managers, public health consultant, principal medical officer, director of public health nursing and primary care finance representatives. The vision screening programme was changed, with the removal of school exit screening and colour vision testing in 2016.

There are no methods for quality monitoring imposed by the government and there has been no research concerning the effectiveness of the vision screening programme. There has been a cost-effectiveness analysis of the vision screening programme, in the form of a report by the Eye Services Review Group (Hse.ie, 2018).

In the Republic of Ireland, vision screening is conducted by ophthalmologists, paediatricians, general practitioners (GPs), area medical officers and public health nurses who have additional vision training (specialist nurse). It is not known how many of these professionals there are per million population. Registered general nurses have been identified as professionals that do not currently perform vision screening, but could do so with additional training. There is specific training provided to perform vision screening; orthoptists provide training for all vision screening public health nurses in the form of a one-day course; there is no practical element to this and no checks of competency. The training is not currently (2018) regularly updated, monitored, or revalidated and it is not accredited or certified.

21.2. Screening programme

The target conditions of vision screening are retinopathy of prematurity (ROP), congenital eye disorders and amblyopia. The healthcare 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 the sections below.

21.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in a hospital (maternity or children's). The tests conducted at this age include eye inspection, fixation, red reflex testing, retinal examination and pupillary reflexes.

21.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician, GP or specialist nurse, in a hospital or child healthcare centre. The tests conducted at this age include eye inspection, fixation and red reflex testing (paediatrician). The sequence of these tests are:

- Birth - Inspection of eyes, red reflex, corneal light reflex
- Postnatal visit - Inspection of eyes, corneal light reflex
- 6 to 8 weeks - Inspection of eyes, red reflex, corneal light reflex
- 3 months - Inspection of eyes, corneal light reflex

Babies are referred for further diagnostic examination after one abnormal test result. The procedure when tests are inconclusive is not defined and will depend on clinical judgement. Referral at this age includes any abnormality or significant concern.

21.2.3. Vision screening - 3 months to 36 months

Infants aged 3 to 36 months are screened by either a specialist nurse or an area medical officer in a child healthcare centre. The tests conducted at this age include eye inspection and fixation. The sequence of these tests are:

- 7 to 9 months - Inspection of eyes, corneal light reflex
- 18 to 24 months - Inspection of eyes, corneal light reflex

Children are referred after one abnormal test result and between one and two inconclusive tests at the screeners' discretion. Referral at this age includes any abnormality or significant concern.

21.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months up to 7 years of age are screened by either a specialist nurse or an area medical officer in a child healthcare centre or at school. The tests conducted at this age include eye inspection, fixation and a visual acuity (VA) measurement. The sequence of these tests are:

- 3.5 years - Inspection of eyes, corneal light reflex
- 4 to 5 years - VA test

Children are referred after one abnormal test result and between one and two inconclusive tests at the screeners discretion. Referral at 4 to 5 years includes failure to see 0.2 logMAR (0.63 decimal, 6/9.5 Snellen) on testing one or both eyes. VA is measured for the only time at school entry (4-5 years), this is not repeated as a screening test at any age. The optotype charts encouraged is Keeler crowded logMAR test but sometimes this is Sonksen crowded logMAR test or Kay picture crowded logMAR test.

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

	Ophthalmologist	Paediatrician	Specialist Nurse	GP	Area Medical Officer
Preterm babies	✓	×	×	×	×
0 to 3 months	×	✓	✓	✓	×
3 to 36 months	×	×	✓	×	✓
3 to 7 years	×	×	✓	×	✓

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

	Eye Inspection	Red Reflex Testing	Fixation	Retinal Examination	Pupillary Reflexes	Visual Acuity
Preterm babies	✓	✓	✓	✓	✓	×
0 to 3 months	✓	✓	✓	×	×	×
3 to 36 months	✓	×	✓	×	×	×
3 to 7 years	✓	×	✓	×	×	✓

Table 3: Location of vision screening for each age group

	Hospital	Child Healthcare Centre	School
Preterm babies	✓	×	×
0 to 3 months	✓	✓	×
3 to 36 months	×	✓	×
3 to 7 years	×	✓	✓

22. Israel

Vision screening representatives for Israel: Dr Lisa Rubin, Paediatrician, Head of the Department of Community Health, School of Public Health, University of Haifa and Prof Yair Morad, Ophthalmologist, Sackler Faculty of Medicine, Tel Aviv University.

22.1. Vision Screening Commissioning and Guidance

In Israel, vision screening is conducted either regionally or nationally depending on the age group and target condition. All regions provide some type of vision screening, but there are differences between protocols. Funding differs between regions and is provided through charity, health insurance, municipalities and the state.

National vision screening is embedded into a general preventative child healthcare screening system. Decisions on what is provided are made with input from a professional advisory board. In the case of national screening there is also input from public health experts. The vision screening programme is only reviewed when a change is needed; any revisions are decided upon by the Public Health Service within the Israel Ministry of Health, based on discussions and expert opinion. Vision screening was implemented in 1983 and has changed since then; there has been update to the pass/fail criteria.

Nationally organised vision screening consists of:

- In first grade there is nationally organised visual acuity screening.
- Developmental vision screening is nationally organised and funded by the government as general preventive childcare.

Regionally organised screening consists of:

- There are regional initiatives by both non-governmental organisations (NGOs), such as the Lions Club, in collaboration with municipalities, as well as the two large municipalities who run preventive child services to provide vision screening.
- National red reflex screening in neonates is performed in all hospitals and paid for by National Insurance Institute; this pays for all birth related hospitalisations.
- Tel Aviv and Jerusalem municipalities that run preventive child care clinics have vision screening for amblyogenic risk factors in 2-year-old children. These are funded by the municipalities.
- Recently vision screening for amblyogenic risk factors in 2-year-old children that was provided in the Haifa sub-district was discontinued due to a lack of funding; this was originally funded by discretionary governmental funds.
- One health fund (Maccabi) provides ophthalmologic examinations for all 1-year-olds covered by their insurance.
- Two NGOs run photoscreening programs in 20 municipalities. These are funded through a charity.

- The Ministry of Health funds vision screening for first grade children in schools delivered by optometrists.

Orthoptists, ophthalmologists, paediatricians, nurses, lay screeners and optometrists conduct vision screening. For the red reflex screen in the hospital, it is the paediatrician or paediatric resident who does the first and discharge neonatal exam. Public health nurses conduct behavioural screen in Well Child Clinics. Either public health nurses or optometrists conduct visual acuity screening in schools. In the Lions clubs, lay personnel conduct vision screening. It is not known how many there are per million population. Some nurses, optometrists, paediatricians do not screen but could do so with additional training; this is also true for general practitioners (GP) and family doctors. Currently, there is no specific or accredited course that provides training for vision screening professionals.

Whilst there is information available on where and what programmes are implemented, there is no information regarding referral rates or outcomes. There are no methods for quality monitoring imposed by the government. There has been research conducted concerning the vision screening programme in Israel, specifically by Eibschitz-Tsimhoni et al. (2000) which was an evaluation of 1 to 2-year old vision screening for amblyogenic risk factors and Ore et al. (2009) which was an evaluation of the reliability of the E-chart as used with Israeli school children. There has been no cost-effectiveness analysis.

22.2. Screening programme

The target conditions screened for by vision screening include cataract and other opacities at birth, reduced strabismus, visual acuity caused by either amblyopia or refractive error. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child. Specific details of the screening offered within each age group are described more fully in the sections below.

22.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened before discharge by an ophthalmologist in a neonatal intensive care unit (NICU) in a hospital. Preterm infants treated in NICU undergo an ROP exam. Criteria are less than 32 gestational weeks or less than 1500 grams birth weight, and they are examined at 6 weeks of age.

22.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician or a nurse in a hospital or a child healthcare centre. The tests conducted at this age include eye inspection, fixation, red reflex testing (paediatrician), eye motility and pursuit movement. Eye inspection and red reflex are conducted at the neonatal exam following birth. A developmental exam is conducted by nurses in well child clinics, this includes: fixation at 1 and 2 months of age, horizontal pursuit movements at 2 months. After one abnormal or one inconclusive test result babies are referred to an ophthalmologist if there is no red reflex or no fixation.

22.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by either an orthoptist or an optometrist in a child healthcare centre, nursery or kindergarten. The tests conducted include eye inspection, fixation, Hirschberg test and pursuit movements. After one abnormal or one inconclusive test result children are referred to an ophthalmologist if there is evidence of strabismus, or no following of a moving target.

22.2.4. Vision screening - 36 months to 7 years

Children aged between 36 months and 7 years are screened four times by a nurse, lay screener or an optometrist in a nursery, kindergarten, or school. The tests conducted at this age include visual acuity (VA), cover/uncover (in two municipalities) and automated screening (PlusOptix). Automated screening is conducted in some nursery schools (currently in 20 municipalities) and kindergartens by lay screeners. In one small programme it is performed by optometrists. School VA is performed by the school nurses or optometrists depending upon the provider and the geographic area. It is measured for the first time at 3 years of age, then repeated at ages 4 years, 6 years and 7 years. The optotype charts used to measure visual acuity include Numbers and Tumbling E at child healthcare centres, and Snellen numbers in schools. These charts are Snellen based, linear format.

Referral criteria at age 3 years are:

- VA less than 6/9 or 2-lines difference
- presence of strabismus

Referral criteria at age 4 years is:

- VA less than 6/12.5 or 2-lines difference

Referral criteria at age 6 are:

- VA of less than 6/9 or 2-lines difference
- presence of strabismus

Referral criteria at age 7 years is:

- visual acuity less than 6/7.5 or 2-lines difference

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

	Paediatric ian	Ophthalm ologist	Nurse	Orthoptis t	Optometr ist	Layscreen er
Preterm babies	×	✓	×	×	×	×
0 to 3 months	✓	×	✓	×	×	×
3 to 36 months	×	×	×	✓	✓	×
3 to 7 years	×	×	✓	×	✓	✓

Table 3: Location of vision screening for each age group

	Hospital	Child healthcare centre	Nursery	Kindergarte n	School
Preterm babies	✓	×	×	×	×
0 to 3 months	✓	✓	×	×	×
3 to 36 months	×	✓	✓	✓	×
3 to 7 years	×	×	✓	✓	✓

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

	RE	EI	RR *	EM	Fix	Hir	CT **	PM	VA	AS ***
Preterm babies	✓	×	×	×	×	×	×	×	×	×
0 to 3 months	×	✓	✓	✓	✓	×	×	×	×	×
3 to 36 months	×	✓	×	×	✓	✓	×	✓	×	×
3 to 7 years	×	×	×	×	×	×	✓	×	✓	✓

* Paediatrician

** Two regions

*** Twenty regions

Key:

RE: Retinal examination; EI: Eye inspection; RR: Red reflex testing; EM: Eye motility; Fix: Fixation; Hir: Hirschberg, CT: Cover/uncover test; PM: Pursuit movements; VA: Visual acuity; AS: Automated screening

23. Italy

Vision screening representatives for Italy: Andrea Lembo, University Eye Clinic San Giuseppe, Milan and Paolo Nucci, University Eye Clinic San Giuseppe, Milan and Davide Bottin, Hospital of Bolzano.

23.1. Vision Screening Commissioning and Guidance

In Italy, vision screening is organised nationally with regional variations between protocols and is embedded into a general preventative child healthcare screening system. Vision screening is funded by national health insurance, with funding allocation determined by local governments.

The content of the vision screening programme is decided upon by public health organisations and local government. It is not known when the vision screening programme was first implemented. The vision screening programme has been changed since its start date, specifically, it has been extended through to other regions of the country. Vision screening is funded based on economic availability; there are no guidelines for funding. In matters of health, there is a certain level of autonomy between the various regions. There are no vision screening guidelines in Italy. It is not known how often the vision screening programme is reviewed, who decides upon any revisions, or how often reviews are funded and take place. There are methods for quality assessment imposed by the government – however, it is not clear how this is conducted.

Vision screening is conducted by ophthalmologists, paediatricians, or orthoptists in either a hospital, school, or external clinics. There is no available data regarding the number of vision screening professionals per million population. Nurses have been identified as general professionals who do not screen, but could do so with additional training. However, there is currently no specific training to perform vision screening.

There has been no cost-effectiveness analysis of the vision screening programme, or any other studies on the effectiveness of the vision screening programme.

23.2. Screening programme

The target conditions of vision screening are retinopathy of prematurity, congenital eye disorders and amblyopia. Children are screened at birth, 1 month and 6 years of age. Every child is invited for vision screening; this is done by the paediatricians. 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 the sections below.

23.2.1. Vision screening - Preterm babies

Preterm babies aged up to 3 months are screened by a paediatrician or ophthalmologist in a hospital. The vision screening tests used include red reflex testing and a retinal examination and this is conducted within the first month of life.

23.2.2. Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by a paediatrician, ophthalmologist, or orthoptist. The vision screening is conducted in a hospital using an eye inspection, red reflex testing and ocular motility assessment. These tests are conducted within the first month of life. The orthoptist will carry out the examination of the eye and the first part of the eye examination (Ocular motility). Only the paediatrician or ophthalmologist perform fundus red reflex examination to diagnose a white pupil. Referral criteria for further diagnostic examination are undefined, but it is known that vision screening is repeated, before referral for further diagnostic examination if there is the presence of abnormal red reflex.

23.2.3. Vision screening - 3 months to 36 months

Children aged 3 months to 36 months are screened by a paediatrician within the paediatrician's office. The tests conducted include eye inspection, red reflex testing, ocular motility assessment and a retinal examination. These tests are conducted between 12-18 months of life. Referral for further examination to an ophthalmologist by the paediatrician occurs after one inconclusive test and vision screening is repeated, before referral for further diagnostic examination if there is the presence of abnormal red reflex.

23.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened twice by a paediatrician, orthoptist, or ophthalmologist in a hospital or school. The tests conducted include eye inspection, red reflex testing, retinal examination, cover test, alternating cover test, stereopsis using the Lang test and visual acuity measurement. Visual acuity is measured for the first time at 3 years of age in a hospital or external clinic and this is repeated for a second time at 6 years of age in schools. Visual acuity is measured by either an ophthalmologist (Tumbling E test), paediatrician (optotype with animal figures), or orthoptist. Vision screening is repeated, before referral for further diagnostic examination if there is the presence of abnormal red reflex. It is not known how many inconclusive tests necessitate referral.

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

	Paediatrician	Ophthalmologist	Orthoptist
Preterm babies	✓	✓	×
0 to 3 months	✓	✓	✓
3 to 36 months	✓	×	×
3 to 7 years	✓	✓	✓

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

	Eye inspection	Red reflex testing	Eye motility	Retinal examination	Cover test	Alternating cover test	Visual acuity measurement	Stereopsis
Preterm babies	×	✓	×	✓	×	×	×	×
0 to 3 months	✓	✓	✓	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	×	×	×	×
3 to 7 years	✓	✓	×	✓	✓	✓	✓	✓

Table 3: Location of vision screening for each age group

	Hospital	Paediatrician office	School
Preterm babies	✓	×	×
0 to 3 months	✓	×	×
3 to 36 months	×	✓	×
3 to 7 years	✓	×	✓

24. Kosovo

Vision screening representative for Kosovo: Dr. Naser Salihu, Faculty of Medicine, University of Prishtina.

24.1. Vision Screening Commissioning and Guidance

In Kosovo, vision screening is organised nationally, with no regional variation. Vision screening is funded through municipalities and is free of charge when it is conducted as part of general screening, however, parents can opt to pay for a private clinic. The content of the vision screening programme is decided upon by the local government health department. It is not known when the vision screening programme began or when it was implemented nationally, however, it is believed not to have changed since its implementation. There are no guidelines for vision screening and no defined process for review of the provision. There are no methods for quality monitoring imposed by the government. There has been no research carried out concerning the vision screening programme in Kosovo and there has been no clinical or cost-effectiveness analysis conducted.

Vision screening is carried out by general practitioners (GP), paediatricians, and ophthalmologists within kindergartens, child healthcare centres, hospitals, private clinics and schools. It is not known how many vision screening professionals there are per million population. There are GPs who do not screen, but could do so with additional training. No other healthcare professionals have been identified that could deliver vision screening with the appropriate training. However, there is currently no specific training available to perform vision screening.

24.2. Screening programme

The target conditions screened for by vision screening are retinopathy of prematurity (ROP), reduced visual acuity or any other eye abnormality. 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 the sections below.

24.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened for ROP by an ophthalmologist within a hospital neonatology clinic. The vision screening tests utilised at this age include eye inspection, red reflex testing and a retinal examination. Retinal changes in ophthalmoscopy are criteria for referral. Premature babies under the ages of 32 weeks and low body weight (less than 1200g) are screened at least once.

24.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened once by an ophthalmologist at either a hospital, child healthcare centre or a private clinic. The vision screening tests used at this age include eye inspection, fixation, red reflex testing, eye motility and pupillary reflexes. The exact age that these tests are carried out between birth and 3 months is not known. Babies are referred for further diagnostic examination after one abnormal or inconclusive test result. Referral is based on the absence of red reflex.

24.2.3. Vision screening - 3 months to 36 months

Babies aged 3 to 36 months are screened by an ophthalmologist at least once, in either a hospital, private clinic, kindergarten (1 to 3 years) or child healthcare centre. Financial status is key, services provided in public hospitals are free of charge. Families with higher incomes tend to willingly and independently send their children for screening in private clinics because of shorter waiting times and greater specialist access.

The vision screening tests utilised at this age include eye inspection, fixation, red reflex testing, eye motility, pursuit movements, cover test, alternating cover test and stereopsis using the Titmus test. Private screening also includes automated screening using various devices (dependent on where screening is conducted) which can include the Welch Allyn Spot Screen Vision device, Topcon, Huvitz, Tomey etc. in children aged 0-3 years and auto-refraction measurements. The age that each of these tests is carried out between 3 and 36 months is not specified. One abnormal or inconclusive test result necessitate referral for further diagnostic examination. Manifest strabismus, or no red reflex are the referral criteria for each category.

24.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened by a GP, paediatrician, or ophthalmologist in either a hospital, private clinic, school, or child healthcare centre. The vision screening tests utilised at this age include eye inspection, fixation, red reflex testing, eye motility, pursuit movements, cover test, alternating cover test, visual acuity measurement, stereopsis and autorefraction (private screening).

The optotype chart used to measure visual acuity is Snellen (single Snellen sized letters), and this is conducted for the first time at the age of 3 years in a child healthcare centre as part of individual vision screening by ophthalmologists.

Visual acuity is measured for a second time between the ages of 6 to 7 years, this is conducted in schools as part of generalised screening. Visual acuity is measured again at the ages of 10 to 11 years and 14 to 15 years of age, in schools as part of generalised screening. After the age of 5 years, visual acuity is measured by a GP, paediatrician, or an ophthalmologist.

One abnormal or inconclusive test result necessitate referral for further diagnostic examination. Low visual acuity of 0.7 decimal (6/8 Snellen, 0.15 logMAR) in one eye, or strabismus are the referral criteria at each age category.

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

	GP	Paediatrician	Ophthalmologist
Preterm babies	×	×	✓
0 to 3 months	×	×	✓
3 to 36 months	×	×	✓
3 to 7 years	✓	✓	✓

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

	EI	RR	RE	Fix	EM	PR	PM	CT	ACT	Stereo	AR	VA
Preterm babies	✓	✓	✓	×	×	×	×	×	×	×	×	×
0 to 3 months	✓	✓	×	✓	✓	✓	×	×	×	×	×	×
3 to 36 months	✓	✓	×	✓	✓	×	✓	✓	✓	✓	✓	×
3 to 7 years	✓	✓	×	✓	✓	×	✓	✓	✓	✓	✓	✓

Key:

EI: Eye Inspection; Fix: Fixation; RRT: Red Reflex Testing; EM: Eye Motility; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Test; VA: Visual Acuity Measurement; SV: Stereoscopic Vision; AR: Autorefracton

Table 3: Location of vision screening for each age group

	Hospital	Private Clinic	Child Healthcare Centre	Kindergarten	School
Preterm babies	✓	×	×	×	×
0 to 3 months	✓	✓	✓	×	×
3 to 36 months	✓	✓	✓	✓	
3 to 7 years	✓	✓	✓	×	✓

25. Latvia

Vision screening representatives for Latvia: Dr Sandra Valeina, Head of Children's Eye Diseases clinic, Children's Clinical University Hospital, Riga and Antra Valdmane, Ministry of Health, Latvia.

25.1. Vision Screening Commissioning and Guidance

In Latvia, state-funded vision screening was introduced in 2013. It is embedded into a general preventative child healthcare screening system, the content of which is decided upon by the Ministry of Health in collaboration with healthcare professionals from the National Health Service and the professional body for ophthalmologists.

Vision screening is organised nationally, with no regional variation between protocols. In Latvia, the government pays for preventive eye examinations for each child, from birth to the year of reaching adulthood.

Vision screening guidelines are detailed in general national health screening guideline documentation. Vision screening for children is recommended at the age between 13 to 24 months, between 3 to 4 years, before attending school and again at the age of 6 to 7 years.

Since the restoration of independence in 1991, vision screening has been nationally implemented and since then the vision screening programme has not changed. The vision screening programme guidance is revisited dependent upon necessity or submitted proposals. Any revisions are decided upon by the Ministry of Health, in collaboration with the healthcare professionals from within the National Health Service. This collaboration is put into place to encourage cabinet regulation and state government adoption. There is no special budget for revisions. In December 2017 a group of paediatric Ophthalmologists from the Children's Clinical University Hospital submitted a suggestion for programme review details of which can be seen in Appendix 1.

Vision screening is conducted by ophthalmologists and general practitioners (GP) in hospitals, child healthcare centres, or private clinics. It is not known how many of these practitioners are involved in vision screening. There are other clinicians who could conduct vision screening if additional training was provided, including nurses and optometrists. Currently there is no specific training to perform vision screening, as it is part of the academic training for ophthalmologists. Every 5 years, medical professionals have to renew their medical practitioner certificate to be able to competently and independently engage in medical treatment.

The government does not provide methods of quality monitoring for vision screening and any information is collected by institutions via statistical reports of treatment within the Centre for Disease Prevention and Control (CDPC). It is not clear if there has been research conducted concerning the vision screening programme carried out in Latvia.

25.2. Screening programme

The target conditions screened for have not been defined; however, the purpose of vision screening is to provide a general examination. 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 the sections below.

25.2.1. Vision screening - Preterm babies

It is not clear what eye screening tests are performed in preterm babies up to the age of 3 months. It is not clear what the sequence of these tests might be, or the pass criteria used for each test used. Any tests that are performed are conducted by an ophthalmologist in a hospital.

25.2.2. Vision screening - Birth to 3 months

Vision screening takes place at child healthcare centres, or at the GP practice, by a neonatologist, GP, paediatrician, or ophthalmologist. The vision screening tests conducted at this age include Bruckner test to assess for presence of strabismus, red reflex test, Hirschberg test, eye motility, cover/uncover test. Retinoscopy, slit lamp examination and ophthalmoscopy are performed under full cycloplegia.

If any of these tests show abnormalities, then they are referred to the Children's Clinical University Hospital Eye Disease Clinic.

25.2.3. Vision screening - 3 months to 36 months

In Latvia, children must have an eye examination at age of 13-24 months, 3 years and 6-7 years; this is specified in the law. Vision screening is conducted by paediatricians, ophthalmologists or a GP and this takes place at the GP practice or ophthalmological clinic. There are no defined criteria for what vision screening tests should be conducted in this age group. These tests and normative responses include:

- Bruckner test for presence of manifest strabismus and red reflex test. Normal reflexes should be the same bright, size in both eyes.
- Visual acuity (VA) with Cardiff or Teller cards at distance 100 or 50 cm, monocular and binocular condition. The test is passed if the VA is similar in both eyes.
- At 3 months of age VA should be 0.06-0.07 decimal (0.06 decimal = 1.22 logMAR, 6/95 Snellen), at 6 months 0.2 decimal (0.70 logMAR, 6/30 Snellen), 12 months 0.2-0.3 decimal (0.2 decimal = 0.70 logMAR, 6/30 Snellen). At 36 months 0.2-0.6 decimal or better (0.2 decimal = 0.70 logMAR, 6/30 Snellen). The test is passed if there is no difference between two eyes (two test lines) or the VA corresponds to the age of the child as outlined above.
- The oriented visual field test is passed if the child observes the object (for example, toy or clinician's fingers) equally with the right and left eyes on all sides.
- Stereovision may be checked from 6 months of age (Lang I and II tests)

- Hirschberg test is passed if no manifest deviation of the eyes
- The cover/uncover test is passed if child has orthophoria
- The eye motility test is passed if the child's eye muscles work symmetrically, with no muscle paralysis.
- Convergence test is passed if near point of convergence is 6-10 cm and recovery point of convergence is 12-15 cm.

The screening is passed if the specialist does not find abnormalities. It is not known how many inconclusive or abnormal test results necessitate referral for further examination.

25.2.4. Vision screening - 36 months to 7 years

There are no specific guidelines concerning which vision screening tests should be conducted on children aged 36 months to 7 years.

- Bruckner test for presence of manifest strabismus and red reflex test. Normal reflexes should be the same bright, size in both eyes.
- VA with Cardiff or Teller cards (at age of 36 months if child does not understand another test) with LEA tests (symbols, numbers), "E" test, Landolt "C" at the 3-6 m and 0.4 m. The test passed if VA is similar in both eyes and within normative expected responses as follows:
 - At age of 36 months children visual acuity is 0.2-0.6 decimal or better (0.2 decimal = 0.7 logMAR, 6/30 Snellen), at age of 4-5 years 0.5-0.9 decimal (0.5 decimal = 0.3 logMAR, 6/12 Snellen) or more, at age of 8 years 0.9-1.0 decimal or better (0.9 decimal = 0.05 logMAR, 6/7 Snellen)
 - The test passed if there is no difference between two eyes (two test lines) or if VA corresponds to the age of the child as outlined above.
- Visual field test by confrontation method, passed if the child observes the object that the specialist is showing equally monocularly with the right and left eyes on all sides.
- Stereovision can be measured by Titmus Fly, Animals, Rings test, TNO test, Lang I and II tests, Two-Pencil test
- Hirschberg test - no observed deviation of the eye/s
- Cover/uncover test passed if child has orthophoria only
- Eye motility test passed if a child's eye muscles work symmetrically, no muscle paralysis.
- Convergence test passed if child near point of convergence is 6-10 cm and recovery point of convergence is 12-15 cm.

Tests passed if the specialist does not find abnormalities. Vision screening is conducted by paediatricians, ophthalmologists, or a GP and this takes place at the GP practice or ophthalmological clinic. It is not known how many inconclusive or abnormal test results necessitate referral for further examination.

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

	Neonatologist	Paediatrician	Ophthalmologist	GP
Preterm babies	Not specified (NS)	NS	NS	NS
0 to 3 months	✓	✓	✓	×
3 to 36 months	×	✓	✓	✓
3 to 7 years	×	✓	✓	✓

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

	Eye examination	RR	EM	Hirschberg	Cover/uncover	visual field	VA	Stereopsis	Conv
Preterm babies	NS	NS	NS	NS	NS	NS	NS	NS	NS
0 to 3 months	×	✓	✓	✓	✓	×	×	×	×
3 to 36 months	✓	✓	✓	×	✓	✓	✓	✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3: Location of vision screening for each age group

	Hospital	GP practice	Child healthcare centre	Ophthalmology clinic
Preterm babies	✓	×	×	×
0 to 3 months	×	✓	✓	×
3 to 36 months	×	✓	×	✓
3 to 7 years	×	✓	×	✓

26. Lithuania

Vision screening representatives for Lithuania: Dr Sandra Valeina, Head of Children's Eye Diseases clinic, Children's Clinical University Hospital, Riga and Antra Valdmane, Ministry of Health, Latvia.

26.1. Vision Screening Commissioning and Guidance

Vision screening is organised nationally in Lithuania, with no regional variation regarding vision screening protocols. Vision screening is funded by the state and the programme provided is embedded into a general preventative child health care system. It is unknown who decides upon the content of the vision screening programme and it is unknown what year the vision screening programme commenced. However, the vision screening programme has been expanded since its commencement. Specifically, it has been extended for all newborn babies whereby red reflex testing is obligatory.

There are no guidelines for vision screening and it is unknown how often the programme is reviewed, who decides on revisions, how often these revisions take place, and how often there is funding for revisions. There are no measures for quality monitoring of vision screening imposed by the government and there is no research pertaining to the clinical or cost-effectiveness of the vision screening programme.

In Lithuania, the professionals that perform vision screening are paediatricians, family doctors (GPs), ophthalmologists and nurses. Vision screening is conducted in hospitals, private clinics and 'other' clinics (defined as polyclinics). Health care services are divided into three levels in Lithuania: Level one - family doctors; Level two – specialists; Level three - university hospitals. The vision screening is performed in all levels, however, it should not be performed in the third level theoretically, but in practice it is done.

It is unknown how many vision screening professionals are practicing in Lithuania. It is stated by the Country Representative (CR) that there are probably some nurses who could be considered as general professionals that do not screen, but could do so with additional training. However, there is no specific training provided for vision screening professionals.

26.2. Screening programme

Vision screening is compulsory in Lithuania at the age of 7 years old, prior to this age, only fundus red reflex is performed as a requirement at birth. Retinopathy of prematurity, congenital eye disorders and amblyopia are the target conditions screened for in Lithuania. 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 the sections below.

26.2.1. Preterm vision screening

Preterm babies are screened using a retinal examination. This is conducted in hospital by an ophthalmologist. Retinal examination is conducted for the premature infants weighing less than 2000g or those born before 33 weeks of gestation. Preterm vision screening for babies born before 26 weeks is performed after the 31 week of the adjusted age. Babies born on or after 27 weeks of gestation are screened 4 weeks after birth.

26.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened once using red reflex testing. This is conducted within the first few days of birth, at the hospital, by either a paediatrician, nurse, ophthalmologist, neonatologists, or obstetricians. Babies are immediately referred for further examination if the test result is abnormal, or inconclusive. Strabismus also necessitates referral for further diagnostic examination. Vision screening may be repeated, before referral for further diagnostic examination, based on the discretion of the doctor.

26.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are tested in family clinics, both public and private, in specialist consulting rooms and university hospitals. This is conducted by an ophthalmologist using 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 (Lang Stereo Test I and II), colour vision and automated screening. These tests are performed between 1 and 3 years of age, over the course of one visit. The disparity between years at which tests are performed is down to there being no unified vision screening calendar, therefore the age at which vision screening takes place is dependent upon the family doctor or the wish of the parents. There are no set referral criteria, the screening is dependent upon the “abilities and competence” of the ophthalmologist and the cooperation of the child. Strabismus also necessitates referral for further diagnostic examination. Vision screening is repeated, before referral for further diagnostic examination based on the discretion of the doctor.

26.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are also tested in the predefined policlinics using 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 (Lang Stereo-test I and II, Stereo Fly test, Stereo Randot test, Stereo Butterfly test), colour vision, autorefraction (Retinomax) and automated screening (PlusOptix). These tests are performed by either an ophthalmologist, paediatrician, or GP. However, paediatricians and GPs are only able to check visual acuity using the Snellen chart as they do not have any other tests or equipment for vision screening in their consulting rooms. The referral criteria for visual acuity for children under the age of 7 years is just approximate and there are no regulated rules for it. Strabismus also necessitates referral for further diagnostic examination. Vision screening is repeated, before referral for further diagnostic examination based on the discretion of the doctor.

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

	Paediatrician	Ophthalmologist	Nurse	Neonatologist	Obstetrician	GP
Preterm babies	×	✓	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	
3 to 36 months	×	✓	×	×	×	×
3 to 7 years	✓	✓	×	×	×	✓

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

	EI	Fix	RR	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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:

EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; Hir: Hirschberg; RE: Retinal examination; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover test; ACT: Alternating cover test; VA: Visual acuity measurement; SV: Stereopsis; CV: Colour vision; AR: Autorefraction; AS: Automated screening.

Table 3: Location of vision screening for each age group

	Hospital	Family clinic	Specialist Consulting Room	Policlinic
Preterm babies	✓	×	×	×
0 to 3 months	✓	×	×	×
3 to 36 months	✓	✓	✓	×
3 to 7 years	×	×	×	✓

27. Luxembourg

Vision screening representative for Luxembourg: Beatrice Bogdan, Orthoptist, Head of Orthoptic Service, Ministry of Health.

27.1. Vision Screening Commissioning and Guidance

Vision screening is organised nationally with no regional variation in protocols. It is funded by the state. It is not embedded into a general preventative child healthcare system. The content of the vision screening programme is decided upon by the Health Directorate, Orthoptic Service. Vision screening was implemented for pre-school children in 1969 and for infants in 1971.

Review of the vision screening programme, how revisions are funded and how and when they take place is not defined. Since its implementation, the vision screening programme has changed in terms of the ages that screening takes place and the use of an autorefractor. The date for these changes is not known.

In Luxembourg, vision screening takes place at the headquarter of the Orthoptic Service and in 7 other locations rented by the Orthoptic Service, including kindergartens, public schools and schools. The professionals that perform vision screening are orthoptists and nurses. However, there are only nine orthoptists active in the screening programme. No other general professionals have been identified that do not screen, but could do so with additional training. There is no organised, specific training in order to perform vision screening.

There are no methods for quality monitoring for vision screening set-out by the government. No research concerning the vision screening programme in Luxembourg has been identified. There has been no cost-effectiveness analysis, or any other studies on the effectiveness of vision screening programme.

27.2. Screening programme

The target conditions screened for by vision screening include retinopathy of prematurity (ROP), amblyopia, reduced visual acuity, refractive error, colour vision defects, manifest and latent strabismus, and anisocoria. 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 the sections below.

27.2.1. Vision screening – Preterm babies

Preterm babies are checked by an ophthalmologist during their stay in the hospital if risk factors due to prematurity are fulfilled. These factors are not known. The child is referred for further diagnostic examination when any pathology is apparent.

27.2.2. Vision screening - Birth to 3 months

The tests conducted on well, healthy babies up to the age of 3 months include Hirschberg and pupillary reflexes. These tests are performed by a paediatrician in either a hospital or a doctor's office during 3 first general health check-ups; less than 48 hours after birth, at age 1 to 10 days and 3 to 8 weeks. The check-ups are mandatory. The child is referred for further diagnostic examination when any pathology is apparent.

27.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened at 10 months of age by an orthoptist at a governmental department. The tests used at this age include ocular motility assessment, Hirschberg test, cover test, alternating cover test, stereopsis using the Lang 1 Test and autorefractometry using PlusOptix (10 months-48 months). The referral criteria at this age category is not known.

27.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened three times by an orthoptist at either a governmental department within the orthoptic service at 36 months to 4 years of age or school from 4 years to 6 years of age. The screening takes place at 36 months, 5 to 5 years of age and 5 to 6 years of age. The tests used within this age group include ocular motility assessment, Hirschberg test, cover test, alternating cover test, visual acuity measurement, stereopsis using the Lang 1 Test, colour vision, automated screening (PlusOptix at 36 months to 4 years of age). Visual acuity is measured for the first time at 36 months using the Rossano-Weiss, Tumbling E and Multivisus (computerised) optotype charts. These are all linear uncrowded tests.

If a child is not screened for visual acuity at 36 months, they are tested at 48 months by an orthoptist at governmental departments. The visual acuity measurement is repeated at ages 4 to 5 years and 5 to 6 years.

At 36 months, the referral criteria is hyperopia, astigmatism or anisometropia over 1.5 diopters, strabismus, heterophoria, exophthalmia, a difference in reflexes on the autorefractor, or visual acuity different in both eyes of less than 0.6 decimal (0.2 logMAR, 6/9.5 Snellen). I

At 48 months, the referral criteria is hyperopia, astigmatism or anisometropia over 1.5 diopters, strabismus, heterophoria, exophthalmia, negative stereopsis, or visual acuity of less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen)).

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

	Paediatrician	Ophthalmologist	Nurses	Orthoptist
Preterm babies	✓ *	✓ *	×	×
0 to 3 months	✓	×	×	×
3 to 36 months	×	×	×	✓
3 to 7 years	×	×	×	✓

* In certain cases

Table 3: Location of vision screening for each age group

	Hospital	Doctor's office	School	Governmental Department
Preterm babies	✓	×	×	×
0 to 3 months	✓	✓	×	×
3 to 36 months	×	×	×	✓
3 to 7 years	×	×	✓	✓

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

	EM	Hir	PR	CT	ACT	VA	S	CV	AS
Preterm babies	*	*	*	*	*	*	*	*	*
0 to 3 months	×	✓	✓	×	×	×	×	×	×
3 to 36 months	✓	✓	×	✓	✓	×	✓	×	✓
3 to 7 years	✓	✓	×	✓	✓	✓	✓	✓	✓ **

* No protocol

** Only up to 48 months

Key:

EM: Eye motility; Hir: Hirschberg test; PR: Pupillary reflexes; CT: Cover test; ACT: Alternating cover test; VA: Visual Acuity measurement; S: Stereopsis; CV: Colour vision; AS: Automated screening

28. Malawi

Vision screening representatives for Malawi: Wakisa Mulwafu, ENT Surgeon, College of Medicine, University of Malawi - ENT Surgeon and Chatonda Manda, Paediatric Ophthalmologist, Lions Sight First Eye Hospital, Blantyre, Malawi.

28.1. Vision Screening Commissioning and Guidance

The vision screening programme began in 2016, but only in the southern region of Malawi. Vision screening takes place in hospitals, private clinics and schools and is funded by the Ministry of Health. It is conducted by optometrists, ophthalmology residents and ophthalmologists. It is estimated that there are 30 vision screening professionals per million population. Nurses and teachers are listed as general professionals that do not screen, but could do so with additional training. However, there is no specific training available to perform vision screening.

Vision screening is not embedded into a general preventative child healthcare screening system. The current provision in the region described (Southern region) is decided upon by a paediatric ophthalmologist.

The vision screening programme has not changed since its implementation and there are no guidelines for vision screening. There are no methods for quality monitoring, imposed by the government and no information is collected concerning the vision screening programme. There has been no research conducted into the clinical or cost-effectiveness of vision screening in Malawi.

28.2. Screening programme

In Malawi, the target condition screened for by vision screening is amblyopia. 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 the sections below.

28.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by a paediatric ophthalmologist. There is no established location of this vision screening, some take place in the eye department of a hospital but ideally it is completed in neonatal units, kangaroo units and under five units. Screening is carried out in babies born with birth weight of less than 1.5kgs. Once in the system, babies would be followed up using the ROP protocol. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements and pupillary reflexes.

28.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician or an ophthalmologist in a hospital or a private clinic at birth and 3 months of age. The tests conducted at this age include eye inspection and red reflex testing. Babies are referred for further diagnostic examination after 1 abnormal test result or 2 inconclusive test results.

28.2.3. Vision screening - 3 months to 36 months

Infants aged from 3 to 36 months of age are screened by an ophthalmologist in a hospital, preferably at 3 years of age, but this may vary. The vision screening tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test retinal examination, pupillary reflexes, cover test and alternate cover test. There is no structured sequence to these tests. Infants are referred for further diagnostic examination after 1 abnormal test result or 2 inconclusive test results.

28.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months up to 7 years of age are screened by an ophthalmologist or an optometrist (visual acuity only) in either a hospital or school. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pupillary reflexes, cover test, alternate cover test and visual acuity measurement. There is no structured sequence to these tests. Infants are referred for further diagnostic examination after 1 abnormal test result or 2 inconclusive test results.

Visual acuity is measured for the first time, usually, at the age of 6-7 years. It is not known when this test is conducted again. The optotype used is Snellen chart. The referral criteria are stated as two-line of difference or a visual acuity of less than 6/9 Snellen (0.2 logMAR, 0.6 decimal). Visual acuity is repeated, before referral for further diagnostic examination, if there is one-line difference or a visual acuity of less than 6/9 Snellen.

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

	Paediatric Ophthalmologist	Ophthalmologist	Paediatrician	Optometrist
Preterm babies	✓	×	×	×
0 to 3 months	×	✓	✓	×
3 to 36 months	×	✓	×	×
3 to 7 years	×	✓	×	✓

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

	EI	EM	Fix	RR	Hir	RE	PM	PR	CT	ACT	VA
Preterm babies	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×
0 to 3 months	×	×	×	✓	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓

Key:

ACT: Alternating Cover Test; CT: Cover Test; EI: Eye Inspection; EM: Eye; Motility; Fix: Fixation; Hir: Hirschberg; PM: Pursuit Movements; PR: Pupillary Reflexes; RE: Retinal Examination; RR: Red Reflex Testing; VA: Visual Acuity

Table 3: Location of vision screening for each age group

	Private Clinic	Hospital	School
Preterm babies	✓	✓	×
0 to 3 months	✓	✓	×
3 to 36 months	×	✓	×
3 to 7 years	×	✓	✓

29. Malta

Vision screening representatives for Malta: Dr Farrugia Sant'Angelo, Principal GP, University of Malta and Primary Health Directorate and Dr Martin Francalanza, Orthoptist, Mater Dei Hospital.

29.1. Vision Screening Commissioning and Guidance

In Malta, vision screening is organised nationally, with no differences between regions. Vision screening is funded by the state and is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by orthoptists. The vision screening programme commenced nationally in 1989 and has been changed since its implementation. Specifically, in 1992 nurses were trained to perform all vision screening tests. In 2014, the screening age of school children was changed from 7 years to 5 years. Cover test and ocular motility have also been added, but the date of this change is unknown. Review of the vision screening programme is funded by the Department of Health and take place through learning sessions and conducted by the principal general practitioner (GP) in charge of the screening programme. The guidelines were last revised five years ago.

Vision screening in Malta is conducted by nurses and GPs, of which there are approximately 10 per million population. Ophthalmologists and paediatricians screen babies in neonatal paediatric intensive care unit only. No other general healthcare professionals have been identified that do not screen, but could do so with additional training. There is specific in-service training in vision screening which lasts between 3 to 4 hours, but this is not accredited or certified. School nurses receive training periodically by the head of orthoptics. This training consists of both theory and practical sessions.

There are no methods for quality monitoring imposed by the government and no research has been conducted concerning the vision screening programme in Malta.

29.2. Screening programme

In Malta, the target conditions screened for are retinopathy of prematurity (ROP), congenital eye disorders and reduced visual acuity. 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 the sections below.

29.2.1. Vision screening - Preterm babies

Preterm babies are screened by an ophthalmologist at 1 month of age in a hospital, or at an out-patient clinic if they have been discharged. The tests conducted at this age include eye inspection and retinal examination.

29.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician in a child healthcare centre. The tests conducted at this age include eye inspection, fixation, red reflex testing and eye motility. These tests are performed at the post-natal visit at 6 weeks. Babies are referred after one abnormal test.

29.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by a nurse or a GP in a child healthcare centre. This is conducted at 2 months, 8 months and 18 months of age. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements, cover test and alternating cover test. Infants are referred after one abnormal or two inconclusive tests.

29.2.4. Vision screening - 36 months to 7 years

Between 36 months and 7 years of age children are screened three times by either a GP or a nurse in schools at 3 years, 5 years and 7 years of age. The tests conducted are fixation, eye motility, pursuit movements, cover test, alternating cover test, stereopsis (Lang Stereotest), colour vision and visual acuity measurement. Children are referred after one abnormal or two inconclusive tests. The optotypes used are Snellen charts and Sheridan-Gardiner single test cards. At 3 years the single-optotype letters are used. The referral criteria are:

- At 3 years of age: Vision less than 6/9 (0.67 decimal, 0.2 logMAR), suspected or manifest strabismus, ocular motility problem or failure of Lang test.
- At 7 years of age: Vision less than 6/6 Snellen (1.0 decimal, 0.00 logMAR) in one or both eyes, failed stereotest, or manifest strabismus

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

	Paediatrician	Ophthalmologist	Nurse	GP
Preterm babies	×	✓	×	×
0 to 3 months	✓	×	×	×
3 to 36 months	×	×	✓	✓
3 to 7 years	×	×	✓	✓

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

	EI	RE	Fix	RR	EM	Hir	PM	CT	ACT	SV	CV	VA
Preterm babies	✓	✓	×	×	×	×	×	×	×	×	×	×
0 to 3 months	✓	×	✓	✓	✓	×	×	×	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×
3 to 7 years	×	×	✓	×	✓	×	✓	✓	✓	✓	✓	✓

Key:

EI: Eye inspection; RE: Retinal Examination; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; Hir: Hirschberg; PM: Pursuit movements; CT: Cover test; ACT: Alternating cover test; SV: Stereopsis; CV: Colour vision; VA: Visual acuity

Table 3: Location of vision screening for each age group

	Hospital	Child Healthcare Centre	School
Preterm babies	✓	×	×
0 to 3 months	×	✓	×
3 to 36 months	×	✓	×
3 to 7 years	×	×	✓

30. Moldova

Vision screening representative for Moldova: Prof Ala Paduca, Associate Professor at State Medical and Pharmaceutical University of Moldova.

30.1. Vision Screening Commissioning and Guidance

Vision screening is organised nationally, there are no regional differences. It is funded by the state and is embedded into a general preventative child healthcare screening system. There is no specific standardised vision screening programme, but there is a national protocol on paediatric strabismus, paediatric cataract and paediatric eye trauma. The content of this protocol is decided upon by the Ministry of Health. There are no guidelines concerning vision screening and no methods for quality monitoring imposed by the government. Any information is collected voluntarily by the ophthalmologist and/or general practitioner (GP) and sent to the statistical centre; therefore very little data is collected. There has been no research conducted regarding vision screening in Moldova.

Vision screening is conducted by ophthalmologists, of which there are 214 in the entire country. Nurses and optometrists have been identified as general healthcare professionals that do not screen, but could do so with additional training. In 2017, the State University of Medicine and Pharmacy of Moldova set-up a 4-year course to train optometrists at Bachelor level. Therefore, it will be three more years until they can be involved in vision screening. Otherwise there is no specific training available to train professionals to perform vision screening.

30.2. Screening programme

In Moldova, the target conditions screened for by vision screening are retinopathy of prematurity (ROP), congenital eye disorders and refractive error. 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 the sections below.

30.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist at the Centre for Mother and Child in the capital city of Chisinau, either within the ophthalmology department or the department for preterm babies. Tests are conducted at 3 to 4 weeks after birth; the tests conducted include eye inspection, fixation, red reflex testing, eye motility, retinal examination, pursuit movements and pupillary reflexes. Referral at this age includes fixation problems, strabismus, white pupil and ROP.

30.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by an ophthalmologist at a family centre. The tests conducted at this age include eye inspection, red reflex testing and pupillary reflexes. There is no specific sequence or age at which these are conducted, but they are conducted by the age of 3 months. It is not known how many abnormal or inconclusive test results determine referral for further diagnostic examination. Referral at this age includes fixation problems, strabismus and white pupil.

30.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months of age are screened by an ophthalmologist, paediatrician, or GP at 3 months of age. Screening is also repeated at 12 months, and between 24 and 36 months. The paediatrician or GP will only look for eye deviation (strabismus) or fixation problems, they do not perform any other tests. If any eye deviation or fixation problem is noted they refer children on to an ophthalmologist. Vision screening takes place in family centres, or parents can opt to take their children to private clinics. The tests conducted 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, automated screening (private clinics only) and retinoscopy. Referral at this age includes fixation problems, strabismus, white pupil, visual acuity of less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen). There are no specific rules regarding referral for further diagnostic examination due to an abnormal or inconclusive result, but children are usually referred after one abnormal or inconclusive test result.

30.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened twice by an ophthalmologist at a family centre, although parents can opt to take their children to a private clinic. The children are examined at 3 years of age and then at 7 years of age. The tests performed at this age 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, colour vision (Ishihara or Rabkin), automated screening (private only), retinoscopy. Prism cover test, Bagolini test and Worth's Lights test are only performed in tertiary hospitals or some private clinics.

Referral at this age includes fixation problems, strabismus, white pupil, visual acuity of less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen). There are no specific rules regarding referral for further diagnostic examination due to an abnormal or inconclusive result, but children are usually referred after one abnormal or one inconclusive test result.

The optotype charts used include Lea symbols, Numbers, Snellen and most commonly Orlova charts (crowded). It is not known if these are logMAR scale, or linear or single optotypes. The charts are not used according to the preferences by the ophthalmologists in the polyclinics, but according to what they have available. Tertiary level hospitals and the private clinics have more choice.

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

	Paediatrician	GP	Ophthalmologist
Preterm babies	×	×	✓
0 to 3 months	×	×	✓
3 to 36 months	✓ *	✓ *	✓
3 to 7 years	×	×	✓

* Eye deviation and fixation problems only

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

	EI	Fix	RR	EM	Hir	RE	PM	PR	CT	ACT	VA	CV	AS	Ret	PCT	BT	WT
Pret erm babi es	✓	✓	✓	✓	×	✓	✓	✓	×	×	×	×	×	×	×	×	×
0 to 3 mon ths	✓	×	✓	×	×	×	×	✓	×	×	×	×	×	×	×	×	×
3 to 36 mon ths	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×
3 to 7 year s	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Highlighted tests are conducted only in tertiary or private clinics.

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Test; VA: Visual Acuity Measurement; CV: Colour Vision; AS: Automated Screening; Ret: Retinoscopy; PCT: Prism Cover Test; BT: Bagolini Test; WT: Worth Test

Table 3: Location of vision screening for each age group

	Centre for Mother and Child	Family Centre	Private Clinic
Preterm babies	✓	×	×
0 to 3 months	×	✓	×
3 to 36 months	×	✓	✓ Optional extra
3 to 7 years	×	✓	✓ Optional extra

31. Montenegro

Vision screening representative for Montenegro: Dr Haris Kujundžić, Ophthalmologist, Clinical Centre of Montenegro.

31.1. Vision Screening Commissioning and Guidance

In Montenegro, vision screening is organised nationally with no differences in protocols between regions. All children are screened in both cities and rural areas. Vision screening is funded by the state and is embedded into a general preventative child healthcare screening programme, the content of which is decided upon and regulated by The Law on Health Care of Population.

There is no data to identify when the vision screening programme began, however, it is known that it has not been changed since its implementation and that it has not been reviewed. There are no methods for quality monitoring of the vision screening imposed by the government. There has been no research into the clinical or cost-effectiveness of the vision screening programme in Montenegro.

Vision screening is conducted by paediatricians in child healthcare centres and hospitals; this is part of general screening programme. Nurses have been identified as general professionals who do not screen but could do with additional training. There is a nurse in every screening team. There is no specific training provided for paediatricians.

31.2. Screening programme

In Montenegro, retinopathy of prematurity, congenital eye conditions and reduced visual acuity are the main target conditions screened for through vision screening. This is shown in Tables 1, 2 and 3 respectively. Details of the screening offered within each age group are described more fully in the sections below

31.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by a paediatrician in a hospital. The tests conducted at this age include eye inspection, fixation, red reflex testing and eye motility.. There are no defined or regulated referral criteria at this age; babies are referred if there is any sign of abnormality. It is not known how many abnormal or inconclusive test results necessitate referral for further diagnostic examination.

31.2.2. 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 and eye motility. These tests are carried out by a paediatrician at either a hospital or a child healthcare centre. There are no defined or regulated referral criteria at this age; babies

are referred if there is any sign of abnormality. It is not known how many abnormal or inconclusive test results necessitate referral for further diagnostic examination.

31.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened using eye inspection, fixation, red reflex testing and eye motility. These tests are conducted by a paediatrician at a child healthcare centre. There are no defined or regulated referral criteria at this age; children are referred if there is any sign of abnormality. It is not known how many abnormal or inconclusive test results necessitate referral for further diagnostic examination

31.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened using eye inspection and visual acuity measurement. These tests are conducted by a paediatrician at a child healthcare centre. The visual acuity measurement is conducted for the first time at 6 years of age using the Amsterdam Picture Chart or Snellen charts. These are linear, crowded charts with a testing range of 0.0-1.0 decimal. Children are referred for further diagnostic examination after one abnormal or one inconclusive test result or in the case of visual acuity of less than 1.0 decimal (0.00 logMAR, 6/6 Snellen).

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

	Paediatrician
Preterm babies	✓
0 to 3 months	✓
3 to 36 months	✓
3 to 7 years	✓

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

	Eye inspection	Fixation	Red reflex testing	Eye motility	Visual acuity measurement
Preterm babies	✓	✓	✓	✓	×
0 to 3 months	✓	✓	✓	✓	×
3 to 36 months	✓	✓	✓	✓	×
3 to 7 years	✓	×	×	×	✓

Table 3: Location of vision screening for each age group

	Child Health Care Centre	Hospital
Preterm babies	×	✓
0 to 3 months	✓	✓
3 to 36 months	✓	×
3 to 7 years	✓	×

32. Netherlands

Vision screening representative for the Netherlands: Dr Jan Roelof Polling, Head of Orthoptics, University of applied sciences of Utrecht.

32.1. Vision Screening Commissioning and Guidance

In the Netherlands, vision screening is organised nationally by 28 Youth Healthcare regions. All children in the Netherlands are offered the same package via the Basic Youth Healthcare (Basic JGZ) package. The Youth Doctors and Youth Nurses offer all care in the Netherlands to all children. However, flexibility in implementation is permitted, vision screeners are free to decide, together with the parent, whether certain elements are not carried out, or carried out in any other way. Local initiatives to omit vision screening are allowed. All regions do however provide vision screening and in general there are no differences. Vision screening is funded by the municipalities and it is embedded into a general preventative child healthcare screening system.

The vision screening programme started regionally between 1965 and 1975, was implemented nationally between 1987 and 1989. The vision screening programme has been changed since its implementation; specifically, in 1987 the first non-binding guideline was published, the first national guideline was released in 2002 and a revision was implemented in 2010. This is currently under revision (2018). The NCJ (Netherlands Center for Youth (child) Healthcare) called for a revision of the guidelines after consulting the Ministry of Health, Welfare and Sport, they provide financial support by means of The Netherlands Organisation for Health Research and Development (ZonMw). There is no regular update. Although review has taken place, there have been no significant changes since 1987 when the addition of visual acuity measurement at 7 years was introduced.

There are no methods for quality monitoring imposed by the government. However, it is carried out by the implementation process included in the development and continuing education, as a regulation for Youth Healthcare Doctors. There may be differences from region to region, but they will all follow and adhere to the guidelines as suggested by their associations. There has been research on the vision screening programme carried out in the Netherlands (Sloot et al., 2017; Sloot et al., 2015; Groenewoud et al. 2010). There has been no cost-effectiveness analysis in the Netherlands.

Vision screening is conducted by Youth Nurses and Youth Doctors within approximately 1400 centres. General professionals identified, that do not screen, but could do so with additional training include orthoptists, optometrists and general practitioners (GP). There is no specific training to perform vision screening. It is incorporated in the general medical training or Youth Doctor training (2 years) and the post-bachelor nursing degree (1 year part-time). The Youth Doctor degree has mandatory re-registration and the Nursing degree has voluntary re-registration. In a period of 5 years, the Youth Doctor must have worked as a doctor for 2,080

hours. Work experience only counts if it meets the requirements of the medical assessment framework. Additionally, the doctor needs to participate in a continuing education programme. Both Youth Doctor and Nursing degrees are accredited.

32.2. Screening programme

The target conditions screened for in the Netherlands are retinopathy of prematurity (ROP) in premature infants, congenital cataract/ other congenital ocular abnormalities in all newborn infants and amblyopia in childhood. 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 the sections below.

32.2.1. Vision screening - Preterm babies

ROP screening is performed on preterm babies born before 32 weeks and/or birth weight of less than 1500 grams. These babies also receive a fundus examination by an ophthalmologist. If these tests are positive, a further examination is conducted by an ophthalmologist as required. If the tests are negative (no ROP), tests conducted include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, retinal examination, pursuit movements (monocular and binocular), pupillary reflexes and cover test (near with fixation), all performed by either a nurse, specialist nurse, or Youth Doctor. These tests are conducted in a hospital and referral is determined by evidence of ROP, no or abnormal fixation at 1 month of age and no or abnormal fixation or pursuit at 2 months of age.

32.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by doctor in a child healthcare centre. Tests are conducted at 1-2 months of age and include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements (monocular and binocular), pupillary reflexes and near fixation cover test. Referral is needed after two abnormal or two inconclusive test results. Criteria that determine referral are absence of red reflex, no or abnormal fixation at 1 month of age and no or abnormal pursuit at 2 months of age.

32.2.3. Vision screening - 3 months to 36 months

Children aged between 3 to 36 months are screened by a specialist nurse or a Youth Doctor in a child healthcare centre. Screening is conducted at:

- 3-4 months: eye inspection, pupillary reflexes and red reflex testing
- 6-9 months: eye inspection, pupillary reflexes, Bruckner and near cover test , eye motility and pursuit movements (monocular and binocular)
- 14-24 months: eye inspection, pupillary reflexes, Bruckner and near cover test, eye motility and pursuit movements (monocular and binocular)

Further criteria that determine referral for further diagnostic examination are failure to fix on own hands at 3 months. Referral is needed after two abnormal or two inconclusive test results..

32.2.4. Vision screening - 36 months to 7 years

Children aged between 36 months up to 7 years of age are screened by a specialist nurse, Youth Doctor, or a practice assistant in a child healthcare centre. The test conducted at this age include:

- 3-Years of age: Visual acuity (VA) (Specialist nurse; nurse practitioner; child healthcare doctor). Further assessments can be conducted on indication of abnormality. These include eye inspection, pupillary reflexes, Bruckner and near cover test, eye motility and binocular pursuit movements (Child healthcare doctor; nurse practitioner)
- 3.9-Years of age: VA (Specialist nurse; nurse practitioner; child healthcare doctor). Further assessments can be conducted on indication of abnormality. These include eye inspection, pupillary reflexes, Bruckner and near cover test, eye motility and binocular pursuit movements (Child healthcare doctor; nurse practitioner)
- 5 to 6-Years of age: VA (practice assistant; specialist nurse; nurse practitioner; child healthcare doctor). Further assessments can be conducted on indication of abnormality. These include eye inspection, pupillary reflexes, Bruckner and near cover test, eye motility and binocular pursuit movements (Child healthcare doctor; nurse practitioner)

VA is measured using the Amsterdam picture chart at ages 3 to 3.9 years of age. The optotypes charts are based on the Snellen principle and are used at 5-metre test distance with optotype sizes of 30, 20, 15, 10, 6 and 5.

Children aged 5 and 7 years have visual acuity measured with the Landolt C which are linear logMAR charts (at 5 metres) with optotype sizes of 0.1, 0.12, 0.15, 0.2, 0.25, 0.3, 0.4, 0.5, 0.65, 0.8, and 1.0. Referral is needed after two abnormal, or two inconclusive test results. Criteria that determine referral for further diagnostic examination are detailed as:

- 3 years of age – VA of less than 5/6 Snellen (0.8 decimal, 0.1 logMAR) in one or both eyes
- 3.9 years of age – VA with Landolt C of worse than 0.5 decimal (0.3 logMAR, 6/12 Snellen equivalent) in both eyes
- 5 years of age – VA with Landolt C of worse than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen equivalent) in both eyes (not allowing >0.1 line of intraocular difference)

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

	Youth doctor	Ophthalmologist	Nurse	Specialist nurse	Doctor	Practice assistant
Preterm babies	✓	✓	✓	✓	×	×
0 to 3 months	×	×	×	×	✓	×
3 to 36 months	✓	×	✓	✓	✓	×
3 to 7 years	✓	×	×	✓	×	✓

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

	ROP	EI	Fix	RR	EM	Hir	RE	PM	PR	CT	VA
Pret erm babi es	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×
0 to 3 mon ths	×	✓	✓	✓	✓	✓	×	✓	✓	✓	×
3 to 36 mon ths	×	✓	×	✓	✓	×	×	✓	✓	✓	×
3 to 7 year s	×	✓	×	×	✓	×	×	✓	✓	✓	✓

Key:

ROP: Retinopathy of prematurity; EI: Eye inspection; Fix: Fixation; RR: Red reflex; EM: Eye motility; Hir: Hirschberg test; RE: Retinal examination; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover test; VA: Visual Acuity measurement

Table 3: Location of vision screening for each age group

	Hospital	Child healthcare centre
Preterm babies	✓	×
0 to 3 months	×	✓
3 to 36 months	×	✓
3 to 7 years	×	✓

33. North Macedonia

Vision screening representatives for North Macedonia: Dr Valvita Reçi, Ophthalmology Resident at University Clinic for Eye Diseases, Skopje and Dr Hristijan Duma, Ophthalmologist, University Clinic, Skopje.

33.1. Vision Screening Commissioning and Guidance

Vision screening in North Macedonia is organised both nationally and regionally, with no variation between protocols. Vision screening is funded through a non-public organisation (the country representative is not able to reveal the name of this) in collaboration with the Ministry of Health and United States Agency for International Development (USAID). Vision problems that are detected on vision screening or eye examinations are treated through funding from public health insurance, however, after 1 year of age, the patient pays 10% of the total cost.

Vision screening is embedded into a general preventative child healthcare screening system. The American Guidelines for Retinopathy of Prematurity (ROP) are used to determine some of the content and guidelines for vision screening. The vision screening programme was started in 2008. There has been no change to the programme since its implementation, however it is reviewed every two years, with paediatric ophthalmologists deciding upon any revisions needed. There is no specific funding for these reviews, it is carried out within the doctor's role.

Vision screening takes place in hospitals, kindergartens and schools and is conducted by ophthalmologists. There are two ophthalmologists that are trained to examine for ROP and a further 6-8 paediatric ophthalmologists that can conduct vision screening. There are general professionals who do not screen, but could do so with additional training, this includes nurses working in eye departments and special needs assistants that work in schools for children with visual impairment. There is specific training provided for vision screening which takes four years to complete. The content of the training is regularly updated, monitored or revalidated and is accredited.

There are no methods of quality monitoring for vision screening imposed by the government and no information is collected. Research has not been conducted concerning the vision screening programme in North Macedonia, and there has been no cost-effectiveness analysis.

33.2. Screening programme

In North Macedonia, ROP, congenital eye defects and reduced visual acuity are the vision screening target condition. 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 the sections below.

33.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in a neonatology unit of a hospital. The tests used include eye inspection, red reflex testing, eye motility, retinal examination and pupillary reflexes. Every baby of less than 36 to 37 gestational weeks, regardless of birth weight, are screened, as well as any baby with a birth weight ≤ 1250 grams.

33.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by an ophthalmologist in a hospital. The tests used include eye inspection, fixation, red reflex testing, eye motility, retinal examination and pupillary reflexes. Babies are referred for further diagnostic examination after two abnormal or inconclusive test results.

33.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by an ophthalmologist at a University Clinic for eye diseases; there are three university eye clinics in North Macedonia. The tests that are conducted include eye inspection, fixation, red reflex testing, eye motility, retinal examination, pupillary reflexes and cover test. Children are referred for further diagnostic examination after two abnormal or two inconclusive test results.

33.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months to 7 years are screened by an ophthalmologist at a University Clinic. The tests that are conducted include eye inspection, fixation, red reflex testing, eye motility, retinal examination, pupillary reflexes, cover test, visual acuity measurement, colour vision and autorefractometry (Topcon RM 8900). The visual acuity measurement is conducted for the first time at 3 years of age using Snellen optotype charts, Tumbling E visual acuity charts and special charts with pictures and symbols, all of which are linear crowded charts. Visual acuity is measured again at 3.5, 4, 5 and 6 years of age; all of which are conducted by an ophthalmologist. All children are offered this screening at each of the ages stated. Children are referred for further diagnostic examination after two abnormal or two inconclusive test results.

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

Table 1	Ophthalmologist
Preterm babies	✓
0 to 3 months	✓
3 to 36 months	✓
3 to 7 years	✓

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

Table 2	EI	Fix	RR	EM	RE	PR	CT	VA	CV	AR
Preterm babies	✓	×	✓	✓	✓	✓	×	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	✓	×	×	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓	✓	×	×	×
3 to 7 years	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; RE: Retinal Examination; PR: Pupillary Reflexes; CT: Cover Test; VA: Visual Acuity Measurement; CV: Colour Vision; AR: Autorefraction

Table 3: Location of vision screening for each age group

Table 3	Hospital	University Eye Disease Clinic
Preterm babies	✓	×
0 to 3 months	✓	×
3 to 36 months	×	✓
3 to 7 years	×	✓

34. Northern Ireland

Vision screening representatives for Northern Ireland: Dr Sara McCullough, Optometrist, University of Ulster and Prof Kathryn Saunders, Professor of Optometry and Vision Science, University of Ulster.

34.1. Vision Screening Commissioning and Guidance

Northern Ireland provides nationally organised vision screening that does not differ across the country. Vision screening is funded by the state and it is embedded into a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by orthoptists and the UK National Screening Committee (UK NSC). It is not known exactly when the vision screening programme began, but it has been running for some decades. The programme has been changed since its implementation; specifically, it has been reduced so that vision screening no longer occurs at entry to secondary education at age 10 to 11 years, nor are vision screening at the two-year-old health check, this is now limited to questions about concern from parent over vision and family history conducted by health visiting nurse.

The vision screening programme has been reviewed twice, once in 2005 and again in 2013. Revisions are funded by the state and decided upon by the UK NSC with guidance from external review and stakeholder. There are methods for quality monitoring imposed by the government through service audits; this is not published or widely available, but the outcomes of the vision screening are entered into the Child Health Surveillance (CHS) system in Northern Ireland.

There is no published research concerning the vision screening programme in Northern Ireland. There has been no cost-effectiveness or effectiveness of the vision screening programmes in Northern Ireland.

Vision screening is conducted by paediatricians, specialist nurses, orthoptists and healthcare support workers. There are approximately 700 vision screening professionals per million population. Nurses are general professionals that do not screen, but could do so with additional training. All training for nursing, optometry, orthoptics and medicine is accredited and/or certified by relevant professional bodies. Vision screening in Northern Ireland uses school nurses (registered nurses) and not lay screeners. Nurses are given a short one-day training on vision screening led by orthoptists. No additional training is required for optometrists or orthoptists involved in current Northern Ireland school vision screening protocols.

Optometrists are the most likely professionals to prescribe glasses for children under 7 years of age, either in hospitals or community practices. Ophthalmologists can prescribe glasses and some paediatric ophthalmologists will do their own refraction, however, most would pass on to the hospital optometrist instead. Other treatment options include patching, penalisation with glasses, atropine, cataract surgery and strabismus surgery, where appropriate. All eligible children are offered treatment.

34.2. Screening programme

The target conditions of vision screening are retinopathy of prematurity (ROP), congenital eye disorders and reduced visual acuity. 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 the sections below.

34.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in a hospital. The tests conducted at this age include eye inspection, fixation, red reflex testing and retinal examination to screen for ROP.

34.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician, general practitioner (GP), or a specialist nurse at a hospital, the home of the child or GP clinic. The tests conducted at this age include eye inspection, fixation and red reflex testing. Paediatricians carries out a check for red reflex before babies leave the hospital. At 6 to 8 weeks, babies attend a visit with the GP to check for red reflex. The specialist nurse visits every month and performs gross inspection for strabismus and asks parents if they have any concerns about their babies' vision. It is not known how many inconclusive or abnormal tests necessitate referral for further diagnostic examination.

34.2.3. Vision screening - 3 months to 36 months

Infants aged 3 to 36 months are screened by a specialist nurse at 2 years of age in the home of the child. Eye inspection is performed and a questionnaire to ask parents about concerns regarding their child's vision and family history. The specialist nurse checks if the child opposes occlusion of either eye at this age. One abnormal or one inconclusive test necessitate referral for further diagnostic examination.

34.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years are screened by a specialist nurse in schools. The test conducted at this age is a visual acuity measurement. One screening visit is conducted at age 4 to 5 years by the school nurse. The optotype chart used is the crowded Keeler logMAR test with 4 letters per line, ranging from -0.3 to 0.8 logMAR acuity scores). Monocular acuity is measured using this chart, with naming or matching. Visual acuity is not tested at any other age. The child fails vision screening if monocular acuity is worse than 0.2 logMAR (0.63 decimal, 6/9.5 Snellen) in either eye. One abnormal or one inconclusive test necessitates referral for further diagnostic examination.

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

	Paediatrician	Ophthalmologist	GP	Specialist nurse
Preterm babies	×	✓	×	×
0 to 3 months	✓	✓	✓	✓
3 to 36 months	×	×	×	✓
3 to 7 years	×	×	×	✓

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

	Eye inspection	Red reflex testing	Fixation	ROP	Visual acuity
Preterm babies	✓	✓	✓	✓	×
0 to 3 months	✓	✓	✓	×	×
3 to 36 months	✓	×	×	×	×
3 to 7 years	×	×	×	×	✓

Table 3: Location of vision screening for each age group

	Hospital	Home	GP clinic	School
Preterm babies	✓	×	×	×
0 to 3 months	✓	✓	✓	×
3 to 36 months	×	✓	×	×
3 to 7 years	×	×	×	✓

35. Norway

Vision screening representatives for Norway: Dr Goran Petrovski, Department of Ophthalmology and Centre of Eye Research, University of Oslo and Dr Olav Haugen, Senior Consultant, Department of Ophthalmology, Haukeland University Hospital.

35.1. Vision Screening Commissioning and Guidance

In Norway, vision screening is organised regionally by the local municipalities, of which there are 420. The responsibility of primary health care, of which vision screening is included, is the responsibility of the municipalities, with Norway's Ministry of Health playing an indirect role through legislation and funding mechanisms. All municipalities provide and fund vision screening, which is embedded into a general preventative child healthcare screening system. Vision screening has been implemented since the 1970s. However, the first written Norwegian guidelines for vision screening in children are from 1998. The content of the vision screening programme is decided upon by the Norwegian Directorate of Health. In 2006, the guidelines were revised; the revised guidelines maintained the inclusion of visual acuity testing at 4 years of age, but now introduced a recommendation as to which visual acuity test should be performed.

There are national general health screening guidelines for vision screening and the programme is revised every 5 to 10 years. A committee appointed by the National Health Authorities decides upon the revisions. The committee responsible for the last guidelines comprised of:

- ophthalmologists
- 1 orthoptist
- 1 optometrist
- 1 special education person (in visual problems)
- 1 special nurse
- 1 GP
- 1 paediatric neurologist
- 1 senior consultant from the health care ministry

There are no methods for quality monitoring imposed by the government and there has been very little research carried out concerning the vision screening programme in Norway.

35.2. Screening programme

The target conditions screened for by vision screening are retinopathy of prematurity (ROP), congenital eye disorders and reduced visual acuity. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child. Specific details of the screening offered within each age group are described more fully in the sections below.

35.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in a neonatal intensive care unit of a hospital. The tests conducted in preterm babies less than 32 weeks gestational age (GA) include ROP screening until full normal vascularisation of the retina. Preterm babies aged above 32 gestational weeks are screened in the same manner as full term babies as described in section 5.2.

35.2.2. Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by a paediatrician, GP, or a specialist nurse in a child healthcare centre. The tests conducted at this aged include eye inspection, fixation and red reflex testing (paediatrician). Red reflex and a general eye exam is tested at birth and 6 weeks of age. Babies are referred as soon as there are signs of abnormality. There is no defined policy for referral or observation when tests are inconclusive, this is at the discretion of the clinician. The red reflex examination is conducted at discharge and is performed by a paediatrician (or paediatrician-in-training). The further screening at the child healthcare centre is usually not performed by a paediatrician, but by GPs (the "general eye examination"). The "general eye examination" from birth to 3 months is defined in the national guidelines, and should include:

- family history of any eye problems
- problems concerning pregnancy or delivery
- examination of red reflex
- examination for any congenital anomaly
- examination for abnormal eye movements
- examination of visual behaviour/fixation pattern and following
- ask for any worry or concern from the parents

35.2.3. Vision screening - 3 months to 36 months

Infants aged 3 to 36 months are screened by a specialist nurse or a GP at a mother and child healthcare centre. Testing is conducted four times during this period: at 3 months, 6 months, 1 year and 2 years of age. The tests conducted include eye inspection, fixation, red reflex testing, Hirschberg test and pupillary reflexes. There is no defined policy for referral or observation when tests are inconclusive; this is left to the discretion of the clinician. Due to low sensitivity and specificity, corneal light reflex and cover test has been omitted as a screening examination in the guidelines from 2006. Referral to an ophthalmologist in the period 3-36 months is based

on a total judgement of both findings and worry from the parents and/or the specialist nurse. Manifest strabismus is also a reason for referral.

35.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years of age are screened once, between 4 and 5 years of age, by a specialist nurse at a mother and child healthcare centre. The tests conducted at this age include eye inspection, red reflex testing and a visual acuity measurement. Visual acuity is measured for the first time at 4-5 years of age, however, there are no recommendations as to which chart to use. In Norway, the Østerberg's chart has been the most commonly used test since the 1970s. To pass the visual acuity test, the child needed to see at least 3 objects on line 4/6 (or 0.67 decimal, 0.2 logMAR) in each eye. If the child failed, he/she were required to repeat the screening test after 1-2 months. If they failed again, he/she would be referred to an ophthalmologist. The LH chart (logMAR principle, uncrowded) is now the recommended chart. The indication for referral is now a visual acuity of less than 3 correct symbols (out of 5) on line 3/4.8 (0.63) in one or both eyes and is not repeated at any other age. Referral is determined by less than 3 correct answers out of 5 symbols on the line 3/4.8 (Snellen 6/9.5 or 0.225 logMAR) on charts measured to be used at 3 metres. A new investigation is conducted within 1-2 months if the child failed; otherwise, referral is necessary through indications based on general exam and medical history.

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

	Paediatrician	Ophthalmologist	GP	Specialist nurse
Preterm babies	×	✓	×	×
0 to 3 months	✓	×	✓	✓
3 to 36 months	×	×	✓	✓
3 to 7 years	×	×	×	✓

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

	Red reflex testing	Eye inspection	Retinal examination	Fixation	Hirschberg	Pupillary reflexes	Visual acuity measurement	General eye exam
Preterm babies	✓ >32 weeks GA	✓ >32 weeks GA	✓ <32 weeks GA	✓ >32 weeks GA	×	×	×	✓ >32 weeks GA
0 to 3 months	✓	✓	×	✓	×	×	×	✓
3 to 36 months	✓	✓	×	✓	✓	✓	×	×
3 to 7 years	✓	✓	×	×	×	×	✓	×

Table 3: Location of vision screening for each age group

	Hospital	Child healthcare centre
Preterm babies	✓	×
0 to 3 months	×	✓
3 to 36 months	×	✓
3 to 7 years	×	✓

36. Poland

Vision screening representatives for Poland: Dr Michal Szuminski, Department of Paediatric Ophthalmology with Strabismus Treatment Centre and Prof Alina Bakunowicz-Łazarczyk, Department of Paediatric Ophthalmology with Strabismus Treatment Centre.

36.1. Vision Screening Commissioning and Guidance

Vision screening is organised nationally in Poland, there are no regional differences. The vision screening programme is not 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 implemented nationally. The programme started in 1980's and has not been changed since its implementation.

Vision screening is conducted by General Practitioners (GP), ophthalmologists, paediatricians and nurses, of which there are approximately 850 per million population. No other general health professionals have been identified who could screen with additional training. There is no specific training to perform vision screening. Vision screening is performed during vaccination visits, invitations are sent by the local GPs office; there is no central database.

There are national general health screening guidelines for vision screening and the programme is reviewed once every several years. Any revisions would be implemented by the Ministry of Health and funded by state health insurance. Any revisions to the vision screening programme are conducted through consultations between the Ministry of Health and ophthalmology consultants.

There are no methods for quality monitoring imposed by the government. There has been no research concerning the vision screening programme carried out in Poland. There has also been no cost-effectiveness or any other studies into the effectiveness of the vision screening programme.

36.2. Screening programme

The target conditions screened for are retinopathy of prematurity (ROP), congenital eye 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 the sections below

36.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist in outpatient clinics or within hospitals using eye inspection and retinal examinations. This occurs four weeks after birth; follow-ups are conducted at 2 to 4 week intervals depending on a diagnosis of ROP.

36.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician or a GP. This is conducted at either 1 or 3 months of age, in a child healthcare centre using a fundus red reflex

examination, fixation and pupillary reflexes. Referral is made if any suspected abnormality is identified, babies are referred for further diagnostic examination after one abnormal or one inconclusive test result.

36.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by either a paediatrician or a GP. This is conducted in the GPs office by both professionals. At the age of 1 to 3 months, fixation is conducted and at the age of 36 months, the Hirschberg test is conducted. Referral is made if any suspected abnormality is identified, children are referred for further diagnostic examination after one abnormal or inconclusive test result.

36.2.4. Vision screening - 36 months to 7 years

Children aged 3 to 7 years are screened by a paediatrician, GP or nurse. This is conducted in a GPs office, where visual acuity (VA) and Hirschberg test are conducted. Colour vision is assessed after the age of 7 years. VA and Hirschberg test are assessed at 3, 4, 5, 6 and 7 years of age.

At the age of 3 years, the GP or paediatrician will conduct the VA assessment, at the age of 7 years, the nurse, GP, or paediatrician will conduct the screening. The optotype charts used for VA measurement are numbers or pictures. These are crowded linear tests or uncrowded single optotypes for pre-schoolers. From the age of 7 years the Snellen chart is used.

At the age of 3 years, one line of VA difference, or strabismus are referral criteria for further diagnostic examination by an ophthalmologist. Children are referred after one abnormal or inconclusive test result.

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

	Paediatrician	Nurse	Ophthalmologist	GP
Preterm babies	×	×	✓	×
0 to 3 months	✓	×	×	✓
3 to 36 months	✓	×	×	✓
3 to 7 years	✓	✓	×	✓

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

	Eye inspection	Red reflex	Fixation	Pupillary reflexes	Retinal examination	Hirschberg	Visual acuity	Colour vision
Preterm babies	✓	×	×	×	✓	×	×	×
0 to 3 months	×	✓	✓	✓	×	×	×	×
3 to 36 months	×	×	✓	×	×	✓	×	×
3 to 7 years	×	×	×	×	×	✓	✓	✓

Table 3: Location of vision screening for each age group

	Child Health Care Centre	Hospital	Outpatient Clinic	GP office	Paediatrician office
Preterm babies	×	✓	✓	×	×
0 to 3 months	✓	×	×	×	×
3 to 36 months	×	×	×	✓	×
3 to 7 years	×	×	×	✓	×

37. Romania

Vision screening representative for Romania: Dr Teodora Cocis, Ophthalmologist, Quality Medical Vision, SRL.

37.1. Vision Screening Commissioning and Guidance

Vision screening in Romania is organised regionally, by the local Lions Clubs. The local Lions Clubs vary according to the region of the country where they are situated, they offer screening in different regions of the country periodically. Screening is offered to children enrolled in state funded kindergartens. There are no differences in protocols operating in each region. In Cluj, vision screening was implemented in 2012 and this ended in 2014; this was the end of the periodic vision screening for this area. In 2012, screening was offered to children enrolled in state-funded kindergartens between the ages of 3 to 6 years. It is estimated that this was the first vision screening offered for this age group.

Retinopathy of prematurity (ROP) screening was implemented in 2002 and is ongoing in the counties where there are medical universities, for instance in Bucharest, Lasi, Cluj and Timisoara. The rest of the counties do not provide ROP screening and instead, each region must rely on periodic vision screening to occur in their respective region. To date, it is estimated that vision screening has been organized by local Lions Clubs in Cluj, Timis, Mures, Arad, Bihor, Vaslui, Prahova, Bacau, Calarasi, Bucuresti, Iasi, Brasov, Sibiu, Hunedoara and Constanta.

The periodic vision screening is funded through charities and university grants with these programmes embedded into a general preventative child healthcare screening system. The content of these vision screening programmes is decided upon by the Lions Club and by a University.

Ophthalmologists conduct vision screening; these professionals go into kindergartens to perform the periodic vision screening. It is estimated that there are less than one ophthalmologist per million population. Nurses and optometrists have been identified as general professionals who do not screen, but could do so with additional training. However, there is currently no specific training available to perform vision screening.

Vision screening takes place in hospitals, child healthcare centres, or kindergartens. The vision screening programme for ROP changed since its implementation when in 2004 it was extended to the entire country. ROP screening is carried out in cities with medical universities and those that have a specialist and the necessary equipment. All children who meet the criteria are screened for ROP. Children from counties with no ROP specialist are referred to the next available ROP screening centre. There are national general vision screening guidelines.

There is no defined mechanism for revision and review of vision screening programmes in terms of frequency, personnel to perform it or funding. The government has not implemented quality monitoring of vision screening and no other mechanism for this is in place; any

information collected is reported on an individual basis by the screening personnel. There has been no research concerning the vision screening programmes, no cost-effectiveness analysis, or any other studies on the effectiveness of vision screening programme in Romania.

37.2. Screening programme

The targets conditions for vision screening are reduced visual acuity (VA), refractive error, strabismus and ROP. 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 the sections below.

37.2.1. Vision screening - Preterm babies

Preterm babies aged up to 3 months are screened by ophthalmologists in neonatology departments, NICUs, Premature Health Care Centres, or Ophthalmology departments for babies discharged home. The tests used are red reflex testing, Hirschberg test, retinal examination and pupillary reflexes.

37.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician, or general practitioner (GP) at either a hospital, child healthcare centre, the child's home or GPs office. At birth, in the neonatology department an eye inspection and pupillary reflex are performed by the neonatologist. After discharge, the GP performs regular general exams at one month intervals. Part of the general examination is eye inspection, pursuit movements and pupillary reflexes. Ophthalmologists perform fundus red reflex testing if a child is referred. Referral is initiated when the paediatrician/neonatologist or GP detect an abnormality during the eye inspection, pursuit movements, or pupillary reflexes. Referral criteria include white pupil, manifest strabismus, nystagmus, evident abnormalities of the eye and surrounding structures (e.g. eye lids), absent pupillary reflexes or no pursuit movement after the age of two months. The child is then immediately referred to an ophthalmologist where further diagnostic tests are carried out. These include automated screening (PlusOptix), red reflex, retinal examination, cover test and an intraocular pressure (IOP) measurement (depending on the findings during the examination). The parents can also request for their child to be seen by an ophthalmologist, irrespective of the result from the GP or paediatrician. If insufficient cooperation is impeding a diagnosis, then an examination is performed under inhalator sedation of the baby.

37.2.3. Vision screening - 3 months to 36 months

No vision screening programmes are currently available in Romania for children of pre-kindergarten age, between 3 months and 36 months.

37.2.4. Vision screening - 36 months to 7 years

Children aged between 36 months and 7 years are screened by an ophthalmologist in kindergarten. This is dependent on whether or not the specific region is benefitting from periodic organised vision screening. Therefore, this screening may take place once at this age, more than once, or not at all. Tests conducted are eye motility, pursuit movements, cover test, alternating cover test, visual acuity measurement and automated vision screening (PlusOptix). After one inconclusive test, the child is referred to an ophthalmologist for a further consultation. Referral criteria for children aged 36 months to 7 years are reduced VA, 0.2 logMAR (0.63 decimal, 6/9.5 Snellen) with 2-line difference, positive cover test (manifest or latent strabismus), or refractive error (hyperopia >3 Dioptres; myopia, astigmatism >1 Dioptres) and/or anisometropia. Visual acuity is tested using a Tumbling E chart, in logMAR, using both crowded and individual optotype cards, with a range of 0.1 – 1.0 at 5 metres. VA measurement is always performed by an ophthalmologist, and this is done for the first time with children aged 3 years. It is not known if a second measurement of visual acuity is taken, and if it is, at what age (as this depends on whether another screening episode takes place).

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

	Ophthalmologist	Paediatrician	GP
Preterm babies	✓	×	×
0 to 3 months	✓	✓	✓
3 to 36 months	×	×	×
3 to 7 years	✓	×	×

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

	EI	RR	EM	Hir	RE	PM	PR	CT	ACT	VA	AS
Preterm babies	×	✓	×	✓	✓	×	✓	×	×	×	×
0 to 3 months	✓	✓	×	×	×	✓	✓	×	×	×	×
3 to 36 months	×	×	×	×	×	×	×	×	×	×	×
3 to 7 years	×	×	✓	×	×	✓	×	✓	✓	✓	✓

Key:

EI: Eye Inspection; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg test; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Tests; VA: Visual Acuity; AS: Automated Screening

Table 3: Location of vision screening for each age group

	Hospital	Hospital	Kinderg arten	Child Healthc are Centre	Parents Home	GPs Office
Preterm babies	✓	×	×	✓	×	×
0 to 3 months	×	✓	×	✓	✓	✓
3 to 36 months	×	×	×	×	×	×
3 to 7 years	×	×	✓	×	×	×

38. Rwanda

Vision screening representative for Rwanda: Lieke Gouma, Orthoptist, Rwanda Charity Hospital.

38.1. Vision Screening Commissioning and Guidance

In Rwanda, vision screening is organised regionally within different districts. There is no data available recording the districts that are not providing vision screening. In the districts providing vision screening the same protocols are followed as most vision screening professionals have been trained by the charity ‘Vision for a Nation’ using the same protocol. However, some individuals may also be conducting vision screening without training.

Community health workers, ophthalmic clinical officers (OCOs) and trained nurses conduct vision screening in health centres. There is three-day training programme to enable these personnel to perform vision screening. The training was designed and developed by Dr Ciku Mathenge in 2011 for ‘Vision for a Nation’. Dr Mathenge has since worked with the World Health Organisation to adapt the course and develop it into a Primary Eye Care (PEC) curriculum for adoption by the WHO Africa region. This was launched in 2018 within the PEC Training Manual (WHO, 2018). The original course used by ‘Vision for a Nation’ very much forms the basis of the manual, including guidelines for screening and the protocols for referring.

In 2018 ‘Vision for a Nation’ stopped working in Rwanda, vision screening has therefore been taken on by Rwanda International Institute of Ophthalmology (RIIO). One of the founders of this organisation is Dr Mathenge, therefore it is likely to continue using the same protocol and training (RIIO, 2019).

It is estimated by ‘Vision for a Nation’ (2018) that there are at least 2,797 professionals with additional training in vision screening for the entire population. There are more nurses that do not screen, but could do so with additional training.

Vision screening is funded through national mandatory health insurance, some of the population can afford private health insurance which may provide vision screening. The programme is not embedded into a general preventative child healthcare screening system.

It is not known when the vision screening programme began, or when it was nationally implemented. However, the programme has not been changed since its start date. The guidelines for vision screening are set out in a national general health screening guideline. It is not known how often the vision screening programme is reviewed; however, any revisions are decided upon and funded by Vision for a Nation. It is not known how revisions might take place and there are no methods for quality monitoring imposed by the government. There has been no research conducted concerning the vision screening programme in Rwanda or any research conducted regarding the clinical or cost-effectiveness of vision screening.

38.2. Screening programme

In Rwanda, the target condition(s) screened for by vision screening are not defined. Specific details of the screening offered within each age group are described more fully in the sections below.

38.2.1. Vision screening - Preterm babies

No vision screening is conducted in preterm babies up to the age of 3 months.

38.2.2. Vision screening - Birth to 3 months

No vision screening is conducted in well, healthy babies up to the age of 3 months.

38.2.3. Vision screening - 3 months to 36 months

No vision screening is conducted in infants aged 3 to 36 months.

38.2.4. Vision screening - 36 months to 7 years

Some children aged from 36 months up to 7 years of age are screened by community health workers, sometimes OCOs and nurses in health centres. Visual acuity measurement is conducted in this age group using Lea Symbols, Numbers, Landolt C, or E Chart; some crowded and some are not. Most commonly, the charts are logMAR uncrowded E-charts, but this is dependent on what is available at the health centre in question. There is no standardised age at which visual acuity is measured for the first time, or at any other age. Follow-up visual acuity checks are dependent upon whether or not the child is complaining of problems. There are no standardised criteria for referral. Children are referred after one abnormal or one inconclusive test.

School screening is currently (January 2019) being piloted, with early reports from April 2019 stating that 15 schools consisting of 19,135 students in total, screened in two months (RIIO, 2019). Of these 763 needed interventions. The age range of children tested is not specified, the test used for VA assessment was the E chart.

39. Scotland

Vision screening representative for Scotland: Mrs Lee Pentland, Pre-school Vision Screening Co-ordinator, Advanced Orthoptist, Ninewells Hospital, Dundee.

39.1. Vision Screening Commissioning and Guidance

In Scotland, there are 14 health boards that form the National Health Service (NHS). At present 12 of the health boards in NHS Scotland are part of the Pre-school Orthoptic Vision Screening (POVS). NHS Orkney and NHS Shetland are islands off of the north coast of Scotland and due to geographical limitations are not currently part of POVS. These health boards have other screening pathways in place but this data is not collected as part of the national service.

Pre-school orthoptic vision screening is funded by the Scottish government and is included within the universal child health review and screening programme. There are nationally agreed guidelines for this service. These were agreed by the Scottish Orthoptic Heads of Service and a steering group led by Public Health Scotland. The Health for all children report (HALL4, 2005) was published in 2005, recommending that all children have vision screening carried out by an orthoptist or another healthcare professional trained by an orthoptist at age 4 to 5 years. By 2014 all mainland Scottish health boards had the POVS service up and running. Prior to this, some boards had locally agreed screening services set up for primary school age (4.5 – 6 years and 5 months). The Scottish government decided pre-school age was best (4 to 5 years) so that children were starting school with the best vision possible.

The steering group meet annually to review the vision screening programme, however, no revisions have been required as yet. Any revisions would be discussed and agreed with the Scottish Orthoptic Heads of Service.

Screening data from POVS is collected on a national form and inputted into a data base with the Information Services Division (ISD) which is a division of the National Services for Scotland (NSS). ISD provides health information, health intelligence, statistical services and advice that support the NHS in progressing quality improvement in health and care and facilitates robust planning and decision making.

Vision screening is conducted by orthoptists (108 conduct screening a part of their role) and orthoptic assistants (unknown number). There have been no general professionals identified that do not screen, but could do so with additional training. The training required is included within the orthoptic 3-year (England) or 4-year (Scotland) degree programmes. The screening involves testing for binocular vision anomalies as well as reduced vision therefore the screening is carried out by a registered orthoptist, with orthoptic assistants.

There are methods for quality monitoring imposed by the government, this consists of an annual audit of each service at board level. National data is also collected and presented at national meetings to enable findings and trends to be discussed. This data collection is

mandatory. Research concerning the vision screening programme in Scotland has been conducted. This found that children from the most deprived backgrounds and those from unstable homes were more likely to fail preschool vision screening (O'Colmain et al., 2015). There is no published cost-effectiveness analysis and no other studies concerning the effectiveness of the vision screening programme in Scotland.

39.2. Screening programme

The target conditions screened for by vision screening in Scotland are Retinopathy of Prematurity (ROP) in preterm infants, congenital ocular defects in all newborns and amblyopia, reduced visual acuity, refractive error and strabismus in pre-school children. 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 the sections below.

39.2.1. Vision screening - Preterm babies

Preterm babies are screened by a paediatric ophthalmologist in hospital, before they are 3 months of age. The tests conducted at this age include red reflex testing, retinal examination and pupillary reflexes. The ophthalmologist would assess preterm babies on the ward in the hospital if they are at risk of ROP. One screening assessment is carried out within the first couple of days following birth. Ophthalmologists then follow Royal College of Ophthalmologists (2008) premature baby guidelines.

39.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened within the first 72 hours of birth, including eyes as part of the Newborn Physical exam. This is followed by screening by a health visitor at 6 to 8-weeks of age. This is carried out in the community which will be in the family home or at the general practitioner (GP) clinic. No tests are performed at this point; the health visitor would instead refer the baby on to a paediatrician if there were any concerns, who would conduct a red reflex test.

39.2.3. Vision screening - 3 months to 36 months

Infants aged from 3 to 36 months are not screened.

39.2.4. Vision screening - 36 months to 7 years

Children aged from 36 months up to 7 years of age are screened once between the age of 3.5 to 5.5 years by an orthoptist in either a nursery school, health centre or hospital eye clinic. Some boards in Scotland have trained orthoptic assistants to test visual acuity (VA); all other tests are carried out by a qualified orthoptist. The tests conducted at this age are eye motility, pursuit movements, cover test, VA measurement and stereopsis.

The tests used are:

- Vision tested with a crowded test
 - Sonksen, crowded, logMAR (range: -0.100 – 0.800), pass mark 0.100 logMAR (0.8 decimal, 6/7.5 Snellen equivalent)
 - Keeler Crowded LogMAR Test (range: -0.100 – 0.800) pass mark 0.200 (0.63 decimal, 6/9.5 Snellen equivalent) Kays pictures crowded logMAR test, pass mark 0.100 (0.8 decimal, 6/7.5 Snellen equivalent) used if the child cannot manage matching letters
- Cover test (near and distance)
- Convergence
- Ocular motility
- Prism reflex test (PRT) - 15 or 20 prism dioptre, base out
- Stereopsis (Frisby or TNO)

The referral criteria are defined as:

- Visual Acuity: Screen to max level of vision of each eye:
 - VA of less than 0.200 (6/9.5) in either eye with Keeler LogMAR or interocular difference of ≥ 0.075 (3 letters)
 - VA of less than 0.100 (6/7.5) in either eye with Sonksen LogMAR or interocular difference of ≥ 0.075 (3 letters)
 - VA of less than 0.100 (3/3.8) in either eye with Kays Pictures Crowded or interocular difference of ≥ 0.075 (3 letters)
- Any manifest deviation including microtropia
- Any significant esophoria, at the discretion of the orthoptist
- Any heterophoria which is not well compensated
- Significant ocular motility defect
- Significantly reduced convergence in combination with negative response on PRT
- All of which are at the orthoptists discretion

Two inconclusive tests necessitate referral for further diagnostic examination, however these children are usually referred to orthoptic clinics in the first instance, rather than refraction by an optometrist or an ophthalmologist. The decision to repeat the vision screening is decided locally and per child. Most boards have the option to recall (re-check) the child prior to referral. This is at the discretion of the orthoptist. Optometrists and ophthalmologists are the only professionals that prescribe glasses for children under the age of 7 years. All eligible children are offered treatment. Treatment options include patching, penalisation with glasses, atropine and cataract surgery.

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

	Paediatric Ophthalmologist	Health visitor	Orthoptist
Preterm babies	✓	×	×
0 to 3 months	×	✓	×
3 to 36 months	×	×	×
3 to 7 years	×	×	✓

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

	PR	RR	EM	RE	PM	CT	VA	S
Preterm babies	✓	✓	×	✓	×	×	×	×
0 to 3 months	×	×	×	×	×	×	×	×
3 to 36 months	×	×	×	×	×	×	×	×
3 to 7 years	×	×	✓	×	✓	✓	✓	✓

Key:

PR: Pupillary reflexes; RR: Red reflex testing; EM: Eye motility; RE: Retinal examination; PM: Pursuit movements; CT: Cover test; VA: Visual Acuity measurement; S: Stereopsis

Table 3: Location of vision screening for each age group

	Hospital	Home	GP clinic	Nursery	Health centre	Eye clinic
Preterm babies	✓	×	×	×	×	×
0 to 3 months	×	✓	✓	×	×	×
3 to 36 months	×	×	×	×	×	×
3 to 7 years	×	×	×	✓	✓	✓

40. Serbia

Vision screening representative for Serbia: Prof Branislav Stankovic, Professor of Ophthalmology, Faculty of Medicine University of Belgrade and Director Strabismus Service, Institute of Ophthalmology Clinical Centre of Serbia.

40.1. Vision Screening Commissioning and Guidance

Vision screening is organised nationally, with no regional variations. It is estimated to have been set-up in 1950 and changed in 2010 to remove vision screening in children aged 2 to 3 years. The programme is funded through health insurance and is embedded within a general preventative child healthcare screening system. The content of vision screening is decided upon by the National Advisory Board for Health Protection for Women, Children and Youth. The national guidelines for vision screening are reviewed every 10 years with the revisions decided upon by the National Advisory Board for Health Protection for Women, Children and Youth. There are no methods for quality monitoring for vision screening imposed by the government.

In Serbia, the professionals who perform vision screening include paediatricians, ophthalmologists, orthoptists and nurses, depending on the age of the child. There are approximately 85 ophthalmologists per million population. No other general professionals have been identified who could deliver vision screening with additional training. There is no specific training to perform vision screening for professionals, instead, paediatricians and ophthalmologists are trained during residency and orthoptists are trained during their academic studies. Training is regularly updated, monitored and revalidated, but only training for paediatricians, ophthalmologists and orthoptists is certified. Nurses are trained by ophthalmologists. At present, the majority of registered nurses do not have any formal ophthalmological education, or any specific training; they are trained by individual ophthalmologists to examine visual acuity accurately.

There has been one piece of research concerning the vision screening programme in Serbia;, an oral presentation at 14th Congress of Ophthalmologists of Serbia, 2013, titled: Importance of preventive ophthalmological examination in 5th year before obligatory entry in preschool institution (Rogošić. et al., 2013). This was published as abstract in Serbian language. This does not include a cost-effectiveness analysis.

40.2. Screening programme

In Serbia, the target conditions screened for by vision screening are retinopathy of prematurity, congenital eye defects, amblyopia 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 the sections below.

40.2.1. Vision screening - Preterm babies

Preterm babies aged up to 3 months are screened by a paediatrician and ophthalmologist in a hospital, at birth before discharge, a child healthcare centre, or a private clinic; dependent upon parental preference of private or public setting. The sequence of testing is as follows: a paediatrician will perform an eye inspection, fixation, eye motility, pursuit movements, Hirschberg test and pupillary reflexes. If there is a suspicion or detection of any problem(s), the child is referred to a child healthcare centre or private practice to see an ophthalmologist. Preterm babies of a birth weight less than 2000 grams, or less than 37 gestational weeks are examined by an ophthalmologist in maternity hospitals in regional centres with a complete ophthalmological examination, including fundus examination. These babies are referred by a paediatrician for follow up in public or a private setting if the parents prefer.

40.2.2. Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by either an ophthalmologist or paediatrician in either a child healthcare centre or a private clinic; this is based on parental preference whether they attend public or private setting. Screening tests include eye inspection, fixation, ocular motility including pursuit eye movements, Hirschberg test, and pupillary reflexes. These tests are conducted by the paediatrician and if the child has a white pupil they are referred to an ophthalmologist to perform a fundus examination. A child is referred to an ophthalmologist after one abnormal or inconclusive test result.

40.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months are screened by a paediatrician in either a child healthcare centre or a private clinic. Screening tests include eye inspection, fixation, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test and stereopsis using Lang I test. Children are screened at every general screening visit. Children are referred to an ophthalmologist if there is any suspected or detected eye problem.

40.2.4. Vision screening - 36 months to 7 years

Children aged between 36 months and 7 years are screened by an ophthalmologist at child healthcare centres and in some cases at kindergartens between the ages of 3 to 4 years. Not all children attend kindergarten. Screening tests include eye inspection, red reflex testing, eye motility including pursuit movements, Hirschberg test, pupillary reflexes, cover test, alternating cover test, stereopsis using Lang I or Randot test, and visual acuity measurement.

Visual acuity is measured using the Snellen chart (range: 0.1 to 1.0 or 1.25 decimal). It is measured for the first time at 3 to 4 years of age, then again at 6 to 7 years of age, and once more at 13 to 14 years of age. Visual acuity is measured by nurses and orthoptists, with two inconclusive or abnormal test results determining referral to an ophthalmologist for further diagnostic examination. Referral criteria necessitating further diagnostic examination is suggested as a low VA for the age of the child, which includes:

- VA of less than 0.5 decimal (0.3 logMAR, 6/12 Snellen) at 5 years or less
- VA of less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) at 6-7 years
- VA of less than 1.0 decimal (0.0 logMAR, 6/6 Snellen) at 13 to 14 years

Other referral criteria include manifest strabismus, or any other significant pathological condition.

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

	Ophthalmologist	Paediatrician
Preterm babies	✓	✓
0 to 3 months	✓	✓
3 to 36 months	×	✓
3 to 7 years	✓	×

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

	EI	Fix	RR	EM	Hir	PM	PR	CT	ACT	VA	SV
Preterm babies	✓	✓	×	✓	✓	✓	✓	×	×	×	×
0 to 3 months	✓	✓	×	✓	✓	✓	✓	×	×	×	×
3 to 36 months	✓	✓	×	✓	✓	✓	✓	✓	✓	×	✓
3 to 7 years	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Tests; VA: Visual Acuity; SV: Stereoacuity test.

Table 3: Location of vision screening for each age group

	Hospital	Kindergarten	Child Healthcare Centre	Private Clinic
Preterm babies	✓	×	✓	✓
0 to 3 months	×	×	✓	✓
3 to 36 months	×	×	✓	✓
3 to 7 years	×	✓	✓	✓

41. Slovakia

Vision screening representatives for Slovakia: Dr Alena Furdova, Ophthalmologist, Comenius University in Bratislava and Dr Dana Tomcikova, Ophthalmologist, Comenius University in Bratislava.

41.1. Vision Screening Commissioning and Guidance

In Slovakia, vision screening is funded through health insurance. The vision screening programme is organised nationally, with no regional variations in protocols. Vision screening is embedded in a general preventative child health care screening system and is performed by paediatricians, ophthalmologists and healthcare support workers within child healthcare centres and hospitals. In Slovakia, there are 1,642 paediatricians and approximately 500 registered ophthalmologists, however it is not known exactly how many of them perform vision screening. No other healthcare professionals have been identified that could screen with additional training. There is no specific training to perform vision screening, instead, this is part of postgraduate education in paediatrics.

The content of the vision screening programme is decided upon by the government and there have been changes made. Currently the vision screening programme for refractive errors and amblyopia is completed between the ages of 3 years and 5 years. The method used by paediatricians, is reading and pictures. The new proposal is to conduct the screening in all children at the age of 3 years using Cardiff or Lea Symbols, combined with cover/uncover test and PlusOptix screening, which should be done in the kindergarten by a qualified nurse. The proposal is not accepted yet, and the tests are currently only completed by paediatric physician.

There are no guidelines for vision screening and there is no protocol for timing of programme revision. Changes are not made on regular basis, they are made when a group of experts make an appeal and it is approved by the Healthcare Ministry. Such revisions are conducted by the Ministry of Health, who also provide funding for such endeavours.

There are no methods for quality monitoring imposed by the government and there has been no research concerning the vision screening programme in Slovakia. There has been no cost-effectiveness analysis and no other studies on the effectiveness of vision screening in Slovakia.

41.2. Screening programme

In Slovakia, retinopathy of prematurity (ROP), congenital eye disorders and amblyopia are the target conditions of vision screening. 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 the sections below.

41.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened in hospitals using eye inspection, fixation, red reflex testing, retinal examination, eye motility, pursuit movements and pupillary reflexes. These tests are performed in part by a paediatrician and also by an ophthalmologist who screens for ROP in all children born before 32 weeks and those who weigh less than 1200 grams. Other babies are evaluated if there are risk factors for ROP. The ophthalmologist will conduct a cataract screening in premature babies at the same time ROP screening is conducted. Preterm babies with or without ROP undergo ophthalmological evaluation until the vascularisation is completed. The parents are then informed about the timing of any subsequent examinations, dependent upon the findings.

41.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened in either a hospital or a child health centre using eye inspection and red reflex testing (5 days to 4 weeks postnatal), fixation and eye motility (at 3 months). The vision screening, including red reflex testing to diagnose a white pupil, is conducted by either a paediatrician or an ophthalmologist. Babies are referred to the ophthalmologist when the paediatrician notices strabismus, an abnormality in anatomical appearance of the eye, and/or when there is an abnormal reaction to a visual stimulus. Babies are referred for further examination after one or two abnormal or inconclusive tests at the doctor's discretion.

41.2.3. Vision screening - 3 months to 36 months

At 12 months of age, children are screened using eye inspection, fixation and eye motility. This is conducted by a paediatrician at a child health centre and repeated at 36 months of age. Children are referred to the ophthalmologist when the paediatrician notices strabismus, an abnormality in anatomical appearance of the eye, and/or when there is an abnormal reaction to a visual stimulus. Babies are referred for further examination after one or two abnormal or inconclusive tests, at the doctor's discretion. .

41.2.4. Vision screening - 36 months to 7 years

Between the ages of 36 months to 7 years, children are screened at the age of 5 years and again at 6 to 7 years of age. At the age of 5, vision screening is conducted at child health centres by paediatricians, using eye inspection, fixation, eye motility and a visual acuity (VA) measurement.

VA is measured for the first time at 5 years of age and it is assessed using E-pfluger (Pfluger hooks are similar to the letter E in a standardised form and size in all directions) and linear picture charts, with a range of 1.0 to 0.1 (decimal). Visual acuity is measured for a second time at either 6 or 7 years of age (dependent on the child availability) by a paediatrician.

If there is one-line difference in visual acuity at the age of 5 years, then children are referred to an ophthalmologist for further diagnostic examination. Children are referred to the ophthalmologist when the paediatrician notices strabismus, an abnormality in anatomical

appearance of the eye, and/or when there is an abnormal reaction to a visual stimulus. Children are referred for further examination after one or two abnormal or inconclusive tests at the doctor's discretion.

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

	Paediatrician	Ophthalmologist
Preterm babies	✓	✓
0 to 3 months	✓	✓
3 to 36 months	✓	×
3 to 7 years	✓	×

Table 3: Location of vision screening for each age group

	Hospital	Child healthcare centre
Preterm babies	✓	×
0 to 3 months	✓	✓
3 to 36 months	×	✓
3 to 7 years	×	✓

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

	RE	EI	RR	EM	Fix	RE	PM	VA	PR
Preterm babies	✓	✓	✓	✓	✓	✓	✓	×	✓
0 to 3 months	×	✓	✓	✓	✓	×	×	×	×
3 to 36 months	×	✓	×	✓	✓	×	×	×	×
3 to 7 years	×	✓	×	✓	✓	×	×	×	✓

Key:

RE: Retinal examination; EI: Eye inspection; RR: Red reflex testing; EM: Eye motility; Fix: Fixation; RE: Retinal examination; PM: Pursuit movements; VA: Visual Acuity measurement; PR: Pupillary reflexes

42. Slovenia

Vision screening representative for Slovenia: Dr Branka Stirn Kranjc, Ophthalmologist, University Eye Hospital, Ljubljana, Slovenia.

42.1. Vision Screening Commissioning and Guidance

In Slovenia, vision screening is organised nationally, all regions provide the same screening with no differences between programmes. Vision screening is funded by the state through compulsory healthcare insurance, and is embedded in a general preventative child healthcare screening system. The content of the vision screening programme is decided upon by the National Institute of Public Health, in collaboration with the government and the professional body of ophthalmologists. Vision screening began in the 1950's and was implemented nationally in the 1960's; it has been changed since its start date, however, it is not clear exactly what changes have been made. There are national general health screening guidelines for vision screening, which are reviewed approximately every 5 years. Revisions are decided upon by the National Institute of Public Health and the professional committees of ophthalmologists and paediatricians.

Vision screening is conducted in child healthcare centres or a public place. There are approximately 400 paediatric nurses and assistant nurses per million population. There are some nurses that do not screen, but could do so with additional training. Specialist nurses and assistant nurses receive 75 hours of ophthalmology training, with repeated training instruction for screening. The training is regularly reviewed as part of the education programme.

There are methods for quality monitoring imposed by the government; this is conducted through the professional committees reporting to the health authorities. There is no systematic collection of information using a national register; instead, this is done through paediatricians referring children who have failed vision screening to the ophthalmic service. There is no research concerning the vision screening programme carried out in Slovenia.

42.2. Screening programme

In Slovenia, the target conditions screened for are retinopathy of prematurity (ROP), congenital eye disorders, amblyopia, reduced visual acuity, refractive error, strabismus, any other ocular anomalies. 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 the sections below.

42.2.1. Vision screening - Preterm babies

Preterm babies, up to the age of 3 months are screened by an ophthalmologist in a hospital. These are identified as babies who weigh less than 1500 grams at birth, or <30-32 weeks gestational age. The vision screening tests utilised at this age include eye inspection, fixation, retinal examination, red reflex testing, pupillary reflexes, eye motility and pursuit movements.

42.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician, in either a hospital or a primary healthcare centre. The vision screening tests utilised at this age include eye inspection, assessment of fixation, red reflex testing, pupillary reflexes, eye motility and pursuit movements. Babies are referred after one abnormal test result or two inconclusive results. Children are referred to an ophthalmologist for further diagnostic examination in the presence of no fixation, pursuit movements, strabismus), nystagmus, optic media opacities, asymmetries, anomalies, neurological reasons, general health problems, or no cooperation for the second time. The criteria used to determine the need for repeat screening before referral for diagnostic assessment is not defined.

42.2.3. Vision screening - 3 months to 36 months

Babies aged between 3 and 36 months are screened by a specialist nurse or assistant nurse in a primary healthcare centre. The vision screening tests administered at this age include eye inspection, assessment of fixation, red reflex testing, pupillary reflexes, eye motility, pursuit movements and Hirschberg test. Referral criteria include congenital structural malformations or anomalies, atypical development for age, misalignment, anisocoria, or opaque optic media. Children are referred after one abnormal test result or two inconclusive results.

42.2.4. Vision screening - 36 months to 7 years

Children aged between 36 months to 7 years are screened by either a specialist nurse or an assistant nurse in a primary healthcare centre. The vision screening tests conducted at this age include eye inspection, assessment of fixation, red reflex testing, pupillary reflexes, eye motility, pursuit movements, Hirschberg test and visual acuity measurement. Visual acuity is tested for the first time at 3 years of age. Professional preferences determine which optotype chart is used. This can include Lea Symbols, Sheridan Gardiner, Snellen, HOTV, and Cambridge acuity cards. Visual acuity is measured for the second time at 3.5 years, and then again at ages 4, 5 and 7 years. Further visual acuity tests are performed every second year of education. Children are referred for further diagnostic examination after one abnormal or inconclusive result. Referral criteria include congenital structural malformations or anomalies, atypical development for age, misalignment, anisocoria, or opaque optic media, 2 lines of visual acuity difference at 3 years of age, a visual acuity of less than 0.4 decimal (0.4 logMAR, 6/15 Snellen).

Stereopsis is not commonly used in screening, but if included may involve the Titmus fly and Lang stereo tests. In primary health care centres, Ishihara colour vision test is used for screening in 7th grade (12-13 years).

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

	Ophthalmologist	Paediatrician	Specialist Nurse	Assistant Nurse
Preterm babies	✓	×	×	×
0 to 3 months	×	✓	×	×
3 to 36 months	×	×	✓	✓
3 to 7 years	×	×	✓	✓

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

	EI	Fix	RE	RR	PR	EM	PM	Hir	VA
Preterm babies	✓	✓	✓	✓	✓	✓	✓	×	×
0 to 3 months	✓	✓	×	✓	✓	✓	✓	×	×
3 to 36 months	✓	✓	×	✓	✓	✓	✓	✓	×
3 to 7 years	✓	✓	×	✓	✓	✓	✓	✓	✓

Key:

EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; VA: Visual Acuity Measurement

Table 3: Location of vision screening for each age group

	Hospital	Primary Healthcare Centre
Preterm babies	✓	×
0 to 3 months	✓	✓
3 to 36 months	×	✓
3 to 7 years	×	✓

43. Spain

Vision screening representatives for Spain: Dr José Miguel Sequí-Canet, Head of Paediatrics, Hospital Francesc De Borja De Gandia and Dr Rosario Gomez de Liaño, Professor of Ophthalmology, Complutense University of Madrid.

43.1. Vision Screening Commissioning and Guidance

In Spain, vision screening is organised nationally, with no regional variation. All regions perform vision screening as part of a general preventative child healthcare screening system. Despite this national programme it is known that some rural areas do not perform all the vision screening tests and there are many differences between regional funding in Spain. Pupillary reflexes and cover tests are always done, but visual acuity is not. Vision screening is funded by the state. The vision screening programme was implemented nationally in 2000, with the content being decided upon by a general screening committee in collaboration with the Strabismus Association and other organisations specific to regions, such as the Conselleria Sanitat in Valencia.

The vision screening programme has been changed since its start date, specifically in 1992 it was extended to include screening in primary care. It has not changed since 1999. There are regional general health screening guidelines for vision screening. The vision screening programme is reviewed when circumstances arise that indicate the need. The revisions are decided upon and funded by the Conselleria Salut, which is a governmental department for health that provides funds for screening. Decisions on revisions are made following meetings with experts, including paediatricians, paediatric nurses and ophthalmologist.

There are no methods for quality monitoring imposed by the government and there has been no research concerning the vision screening programme in Spain. Therefore, there is no data to determine the exact differences between vision screening in larger city regions and rural areas of Spain.

43.2. Screening programme

The target conditions screened for in Spain are retinopathy of prematurity (ROP), congenital eye disorders and reduced visual acuity. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child. Specific details of the screening offered within each age group are described more fully in the sections below.

43.2.1. Vision screening - Preterm babies

Preterm babies up to the age of 3 months are screened by an ophthalmologist and a paediatrician in hospital, and then an outpatient clinic. The tests conducted at this age include eye inspection, red reflex testing, eye motility, retinal examination and pupillary reflexes. In preterm babies, the paediatrician conducts the pupillary reflexes and ophthalmologist conducts all the other

tests. Referral is necessary if there is presence of white pupil or no reflex, as well as any other ocular anomaly.

43.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by a paediatrician at child healthcare centres (public health centre) or private clinics. The tests conducted at this age include eye inspection, red reflex testing, eye motility and pupillary reflexes. These tests are conducted every month up to 3 months of age. Babies are referred to an ophthalmologist after two abnormal test results, but they are not referred for any inconclusive results unless there is suspicion of pathology. Referral is necessary if there is presence of white pupil or no reflex, as well as any other ocular anomaly.

43.2.3. Vision screening - 3 months to 36 months

Children aged 3 to 36 months of age are screened by a paediatrician in either a public health centre or a private clinic, depending on whether parents opt for private or public screening. The tests conducted at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pupillary reflexes and cover test. Children are referred to an ophthalmologist after two abnormal test results, but they are not referred for any inconclusive results unless there is suspicion of pathology. Referral is necessary if there is presence of white pupil, no red reflex, if the child fails the Hirschberg test and if there is any other ocular anomaly including suspicion of intermittent or manifest strabismus at 6 months of age.

43.2.4. Vision screening - 36 months to 7 years

Children aged 36 months up to 7 years of age are screened by either a nurse, optometrist, or a paediatrician in an external office. Screening can be conducted once per year, but usually it is carried out at 4 years and 6 years of age. The tests conducted include eye inspection, fixation, red reflex testing, eye motility, pursuit movements, pupillary reflexes, cover test, alternating cover test, colour vision (sometimes, not always) and visual acuity measurement. Children are referred to an ophthalmologist after one abnormal test result. They are not referred for any inconclusive results unless there is suspicion of pathology. Referral is necessary if there is presence of white pupil, no reflex, if there is presence of reduced vision and if there is any other ocular anomaly. Visual acuity screening takes place for the first time at 4 years of age. Visual acuity is measured again at 6 years of age, and then again between 11 and 14 years old. The optotype charts utilised include, most commonly Pigassou chart and Snellen, but Amsterdam picture chart and in some cases Lea Charts are used. The referral criteria include:

- < 0.5 decimal (0.3 logMAR, 6/12 Snellen) at less than 4 years
- < 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) at age 4 years or more
- < 1.0 decimal (0.0 logMAR, 6/6 Snellen) and a difference in visual acuity of less than 0.1 decimal at 7 years or above.

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

	Paediatrician	Ophthalmologist	Nurse	Optometrist
Preterm babies	✓	✓	×	×
0 to 3 months	✓	×	×	×
3 to 36 months	✓	×	×	×
3 to 7 years	✓	×	✓	✓

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

	EI	Fix	RR	EM	RE	Hir	PM	PR	CT	ACT	CV	VA
Preterm babies	✓	×	✓	✓	✓	×	×	✓	×	×	×	×
0 to 3 months	✓	×	✓	✓	×	×	×	✓	×	×	×	×
3 to 36 months	✓	✓	✓	✓	×	✓	×	✓	✓	×	×	×
3 to 7 years	✓	✓	✓	✓	×	×	✓	✓	✓	✓	✓	✓

Key:

EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; RE: Retinal examination; Hir: Hirschberg; PM: Pursuit movements; PR: Pupillary reflexes; CT: Cover Test; ACT: Alternating cover test; CV: Colour vision; VA: Visual acuity measurement

Table 3: Location of vision screening for each age group

	Hospital	Outpatient clinic	Public health centre	Private clinic	External office
Preterm babies	✓	✓	×	×	×
0 to 3 months	×	×	✓	✓	×
3 to 36 months	×	×	✓	✓	×
3 to 7 years	×	×	×	×	✓

44. Sweden

Vision screening representative for Sweden: Dr Emelie Gyllencreutz, Ophthalmologist, Skaraborg Hospital.

44.1. Vision Screening Commissioning and Guidance

Vision screening in Sweden is organised regionally in all twenty regions. All regions deliver vision screening, but operate using different referral criterion. Vision screening is funded by each region and is embedded into a general preventative child healthcare screening system.

The information provided for this report is based upon the service provision in Sahlgrenska Akademin in region of Gothenburg.

The vision screening programme began in 1968 and was implemented across Sweden in 1973. There have been the following changes since its implementation:

- The referral criteria which once stated that the nurse should refer 4-year old children with visual acuity less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) in each eye, and 5-year old children with visual acuity less than 1.0 decimal (0.0 logMAR, 6/6 Snellen) in each eye. These referral criteria have been withdrawn.
- The vision charts used in each area. Gothenburg and surrounding areas (with about 1.5 million inhabitants) continue to use HOTV-charts but in some parts of Sweden Lea symbols charts are used.

There are regional general health screening guidelines which include vision screening. There is no defined review process of the vision screening programmes, therefore they are not regularly reviewed or changed. There are no methods for quality monitoring imposed by the government.

In Sweden, vision screening is conducted by ophthalmologists, paediatricians, general practitioners (GP) or specialist nurses in either a school, hospital or child healthcare centres depending on the age group. It is not known how many vision screening professionals there are for every million people and no general professionals have been identified that do not screen, but could do so with additional training. There is no specific training currently available to perform vision screening in Sweden.

There has been research carried out concerning the vision screening programme in Sweden, including the clinical effectiveness of the vision screening programme, Gyllencreutz et al., 2018; Hard, 2007; Hard et al., 2002; Kvarnström & Jakobsson, 2005; Kvarnström et al., 1998. There has been no cost-effectiveness analysis.

44.2. Screening programme

Amblyopia is the target condition screened for in Sweden. 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 the sections below.

44.2.1. Vision screening - Preterm babies

Preterm babies, born 36 weeks gestational age or earlier, are screened by either an ophthalmologist within a hospital, if they are. The vision screening tests utilised for preterm babies include only retinal examination.

44.2.2. Vision screening - Birth to 3 months

Well, healthy babies aged up to 3 months are screened by either a paediatrician or GP in hospital or a child healthcare centre. The vision screening tests utilised include eye inspection, fixation, red reflex testing and pupillary reflexes. Red reflex testing and eye inspection are carried out at birth. At the age of 4-6 weeks, red reflex testing is repeated along with pupillary reflexes, eye inspection and fixation. Babies are immediately referred to an ophthalmologist for further examination if disease is suspected, such as cataract or retinoblastoma.

44.2.3. Vision screening - 3 months to 36 months

Babies aged 3 to 36 months are screened three times by a GP or a specialist nurse in a child healthcare centre. This is carried out at 6 months, 10 to 12 months, and 18 months of age. The vision screening tests utilised at these ages are eye inspection, fixation, eye motility and Hirschberg test. Referral for further diagnostic examination is made to an ophthalmologist after a maximum of two inconclusive or abnormal screening test results. Whether it is one or two screening tests administered before referral is determined based on the clinical judgement of the specialist nurse conducting the screening.

44.2.4. Vision screening - 36 months to 7 years

Children aged 36 months to 7 years are screened twice by a specialist nurse. At the age of 4 years, vision screening is carried out in child healthcare centres. At the age of 6 to 7 years, vision screening is carried out in schools. The vision screening test utilised is a visual acuity measurement, this is conducted for the first time at 4 years of age (a re-test is conducted at 5 years of age if the result at 4 years is not acceptable) and then once more at the age of 6 to 7 years. The optotype charts used to measure visual acuity include Lea Symbols (LH), Konstantin Moutakis (KM) and HOTV, all of which are linear, crowded charts with a range of 0.1 to 1.0 (decimal). At 4 and 5 years of age, HOTV or LH are recommended in the national guidelines. The referral criteria is decided regionally, and there are no national guidelines for screening school children. In the Gothenburg region, KM-chart is recommended but some schools in the region still use old E-charts. Referral for further diagnostic examination is made to an ophthalmologist after a maximum of two inconclusive or two abnormal screening test results.

Whether it is one or two screenings is determined based on the clinical judgement of the specialist nurse conducting the screening.

The referral criteria is:

- At 4 years using HOTV = < 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) in each eye. But if the child has VA of 0.65 decimal (0.2 logMAR, 6/9.5 Snellen) in one or both eyes they are retested at 5 years before referral.
- At 6-7 years using KM = < 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) in both eyes.

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

	Paediatrician	Specialist nurse	Ophthalmologist	GP
Preterm babies	×	×	✓	×
0 to 3 months	✓	×	×	✓
3 to 36 months	×	✓	×	✓
3 to 7 years	×	✓	×	×

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

	EI	Fix	RR	EM	Hir	RE	PR	VA
Preterm babies	×	×	×	×	×	✓	×	×
0 to 3 months	✓	✓	✓	✓	×	×	✓	×
3 to 36 months	×	×	✓	✓	×	×	×	×
3 to 7 years	×	×	×	×	×	×	×	✓

Key:

EI: Eye inspection; Fix: Fixation; RR: Red reflex testing; EM: Eye motility; Hir: Hirschberg; RE: Retinal examination; PR: Pupillary reflexes; VA: Visual acuity measurement

Table 3: Location of vision screening for each age group

	Hospital	School	Child Healthcare Centre
Preterm babies	✓	×	×
0 to 3 months	✓	×	✓
3 to 36 months	×	×	✓
3 to 7 years	×	✓	✓

45. Switzerland

Vision screening representative for Switzerland: Dr Veit Sturm, Head of the Department of Strabology and Neuro-Ophthalmology at the Eye Clinic of the Cantonal Hospital St. Gallen and Titular professor at the University of Zurich.

45.1. Vision Screening Commissioning and Guidance

In Switzerland, vision screening is not embedded into a general preventative child healthcare screening system. It is organised regionally (Cantons) therefore differences exist between regions in relation to coverage, personnel delivering screening, tests used and funding. Vision screening is funded through either mandatory health insurance, the state or municipalities.

The content of the vision screening programme is decided upon by those professionals involved in screening within each region. There is no consensus on this, most often an official physician, (“cantonal doctor”) decides on the procedure. However, the screening content itself is managed by the performing personnel.

It is not known when vision screening began, or when it was implemented nationally. It is not known if the vision screening programme has been changed since its start date and there are no guidelines or general regulations for vision screening. If there are any revisions to a programme, this is decided upon on a regional basis with no regulations pertaining to how revisions take place or the funding of this work.

In Switzerland, paediatricians, midwives, nurses, specialist nurses, ophthalmologists, orthoptists and general practitioners (GP) conduct vision screening. It is not known how many of these professionals there are, per million population. No other general healthcare professionals have been identified that could deliver vision screening with additional training. Currently there is no specific training to perform vision screening, healthcare professionals gain this knowledge from their general training.

There are no methods for quality monitoring imposed by the government and no information is collected. There has been research carried out concerning the effectiveness of a vision screening programme in Switzerland (Eppenberger et al., 2016) which assessed the current local situation in the canton of St. Gallen and found that there was variation between locations. No research concerning the cost-effectiveness.

45.2. Screening programme

In Switzerland, the target conditions screened for include retinopathy of prematurity (ROP), congenital eye disorders, amblyopia, reduced visual acuity, refractive error, colour vision

defects 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 the sections below. It is also important to note that there is no consensus and therefore vision screening procedures vary depending on regions and/or professional screening. The information available and given below is generally indicative of Switzerland, but relates specifically to the Canton of St. Gallen.

45.2.1. Vision screening - Preterm babies

Preterm babies, up to the age of 3 months, are screened by an ophthalmologist in a neonatology department of a hospital. Preterm babies are determined as < 32 weeks gestational age and/or ≤ 1500 grams, or with oxygen supplementation > 3 days. Ophthalmoscopy (slit lamp examination if necessary) is performed according to the international guidelines. Otherwise, light reflex test is performed in the first week, month 1 and month 2 according to the guidelines of the Swiss Society of Paediatrics. The vision screening tests utilised include eye inspection, fixation and retinal examination; this is dependent upon age and weight.

45.2.2. Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician, midwife, specialist nurse, ophthalmologist or orthoptist. The vision screening tests administered at this age include eye inspection, fixation, retinal examination and pupillary reflexes. The screening is performed in the first week, month 1 and month 2. These tests are conducted in either a hospital, child healthcare centre, or a private clinic. Criteria that necessitate referral to an ophthalmologist for further diagnostic examination include any eye abnormality (e.g. leukocoria etc.). There are no consensus guidelines for referral, it is at the discretion of the examiner. Vision screening is not repeated, before referral for further diagnostic examination, children are referred immediately if they do not pass the screening procedure.

45.2.3. Vision screening - 3 months to 36 months

Infants aged from 3 to 36 months are screened by either a paediatrician, specialist nurse, ophthalmologist, orthoptist, optometrist/optician, or GP. The vision screening tests administered at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis (no consensus, most often Lang I and II, Titmus) and colour vision (no consensus, most often Ishihara). Autorefractometry (Retinomax Autorefractor) and automated screening (PlusOptix) are sometimes performed, but this depends on the examiner. These tests are conducted in either a hospital, child healthcare centre, kindergarten, school, private clinic, or public place.

Visual acuity (VA) is measured for the first time at age 2.5 years and the optotype charts used include Cardiff Acuity Cards, Lea symbols, Snellen, Tumbling E, Landolt C and Numbers. For

each chart it is variable in terms of whether they are logMAR, linear, crowded or uncrowded charts, the range of optotype sizes used, or if different visual acuity charts are used for different ages and how this differs between regions. This is due to the fact that there is no consensus and it is dependent upon the preferences of the examiner. It is dependent upon the examiner as to when visual acuity is measured again and there is no consensus for this. VA is measured by either a paediatrician, specialist nurse, ophthalmologist, orthoptist, optometrist/optician, or a GP. Criteria that necessitate referral to an ophthalmologist for further diagnostic examination include VA of equal to or less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen), 1 or 2 lines difference in visual acuity, lacking stereovision, or any other eye abnormality (e.g. leukocoria). This is true for large cities including Zurich, however it depends on the individual screening as there are no consensus guidelines. Vision screening is not repeated, before referral for further diagnostic examination, children are referred immediately if they do not pass the screening procedure.

45.2.4. Vision screening - 36 months to 7 years

Children aged between 36 months and 7 years receive vision screening delivered by either a paediatrician, specialist nurse, ophthalmologist, orthoptist or a GP in hospitals, child healthcare centres, kindergarten, schools, private clinics, or public places. The vision screening tests administered at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis (no consensus, most often Lang I and II, Titmus) and colour vision (no consensus, most often Ishihara). Autorefraction (Retinomax Autorefractor) and automated screening (PlusOptix) are sometimes performed, but this depends on the examiner.

The optotype charts used include Cardiff Acuity Cards, Lea symbols, Snellen, Tumbling E, Landolt C and Numbers. Criteria that necessitate referral to an ophthalmologist for further diagnostic examination include a VA of equal to or less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) 1 or 2 lines difference in VA, lacking stereovision, or any other eye abnormality (e.g. leukocoria etc.). This is true for large cities including Zurich, however it depends on the individual screening as there are no consensus guidelines. Vision screening is not repeated, before referral for further diagnostic examination, children are referred immediately if they do not pass the screening procedure.

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

	Paediatrician	Midwife	Specialist Nurse	Ophthalmologist	Orthoptist	Optometrist	GP
Preterm babies	×	×	×	✓	×	×	×
0 to 3 months	✓	✓	✓	✓	✓	×	×
3 to 36 months	✓	×	✓	✓	✓	✓	✓
3 to 7 years	✓	×	✓	✓	✓	×	✓

Table 3: Location of vision screening for each age group

	Hospital	Child Healthcare Centre	Kindergarten	Private Clinic	School	Public Place
Preterm babies	✓	×	×	×	×	×
0 to 3 months	✓	✓	×	✓	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓

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

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

Key:

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

46. Turkey

Vision screening representative for Turkey: Prof Huban Atilla, Ophthalmologist, Ankara University, Department of Ophthalmology.

46.1. Vision Screening Commissioning and Guidance

In Turkey, vision screening is conducted primarily by family practitioners (GPs) and paediatricians, however, parents can opt to pay for their child to see an ophthalmologists. The vision screening programme began and was implemented nationally in 2015. The content of the screening programme was decided by the Ministry of Public Health Department following consultation with the Turkish Ophthalmological Association. Vision screening is organised nationally, with no known regional variation in protocols. However, variation is possible due to the fact that there are no methods for vision screening to be monitored by the government. At present vision screening is not embedded in a general preventative child health care screening system. Vision screening is funded by health insurance and the state, however if parents are willing to pay, they can opt to have their child assessed by an ophthalmologist.

Examinations take place in hospitals, private clinics, or at the offices of GPs. Currently, midwives and nurses do not undertake vision screening, but could do so following additional training. All GPs complete a one-day training programme in order to perform vision screening. During this one day programme, a didactic course about the screening programme and the red reflex test is given by two ophthalmologists during a morning session. A practical course is then given by the same ophthalmologists in the afternoon. Paediatricians are trained during residency; this includes lectures by ophthalmologists. Competencies for GPs and paediatricians are not checked. Regular education and statistical analysis are undertaken to update, monitor and revalidate the training programme. However, the training is not accredited or certified.

Current guidelines have not been revisited since its implementation. However, a review of any guidelines would be the responsibility of the Ministry of Health. The Ministry of Health Statistics department collects information, but this is not accessible. To date, there has been no research conducted in Turkey evaluating the vision screening programme and there has been no analysis into cost-effectiveness.

46.2. Screening programme

GPs follow the population in their area and as a part of the infant-child follow up programme, the follow-ups and the vaccinations are conducted by the GP. However, some families prefer to be followed by paediatricians, in this case the GP still has to follow the child and should

confirm completion of the screening programme and the vaccinations and ask information from the family about the tests or vaccinations.

The target conditions for vision screening at the age of 3 months of age are structural anomalies, cataracts and strabismus. Target conditions in children aged 3 months to 7 years have not been defined. 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 the sections below.

46.2.1. Vision screening - Preterm babies

The vision screening tests performed in preterm babies up to 3 months of age are eye inspection, red reflex testing, Hirschberg test, retinal exam and pupillary reflexes. Vision screening is conducted at the GPs office, paediatrician's office or at the hospital. All tests are carried out by a paediatrician or GP unless parents opt to take their child to an ophthalmologist. If a child is found to have an abnormal screening result, they are referred for diagnostic testing. If the results of the screening tests are inconclusive, or if there is insufficient cooperation, the child is also referred for diagnostic testing. All children who fail vision screening at this age are referred to an ophthalmologist. Referral is based on asymmetric or absence of red reflex, structural anomaly, family concern about strabismus, family history of high refractive errors or strabismus or other ocular diseases like cataracts.

46.2.2. Vision screening - Birth to 3 months

The vision screening tests conducted in well, healthy babies up to the age of 3 months include eye inspection, red reflex testing, Hirschberg test and pupillary reflexes. Vision screening for children of this age is conducted at the Child Health Centre, GPs office, or paediatrician's office. All tests are carried out by a paediatrician or GP unless parents opt to take their child to an ophthalmologist. If a child is found to have an abnormal screening result, then they are referred to an ophthalmologist for diagnostic testing. If the results of the screening tests are inconclusive, or if there is insufficient cooperation, the child is also referred for diagnostic testing. The criteria for referral and diagnostic testing includes asymmetric or absence of a red reflex, structural anomaly, family concern about strabismus, family history of high refractive error, strabismus or other ocular conditions (e.g. cataract).

46.2.3. Vision screening - 3 months to 36 months

It is recommended that a red reflex examination is performed at every visit between the ages of 3 months and 36 months if a child visits a GP or a paediatrician. Parents can opt to pay for assessments by an ophthalmologist, and in this instance, tests would include normal eye inspection, eye motility, red reflex, Hirschberg test and pupillary reflexes. If a child is found to have an abnormal screening result, then they are referred for diagnostic testing. If the results of the screening tests are inconclusive, or if there is insufficient cooperation, the child is also

referred for diagnostic testing. All children who fail vision screening at this age are referred directly to an ophthalmologist. The criteria for referral and diagnostic testing includes asymmetric or absence of a red reflex, structural anomaly, family concern about strabismus, family history of high refractive error, strabismus or other ocular conditions (e.g. cataract).

46.2.4. Vision screening - 36 months to 7 years

Vision screening is primarily conducted by a paediatrician or GP, unless parents opt to take their child to an ophthalmologist. A visual acuity (VA) measurement is mandatory between the ages of 36-42 months. If a family opts to pay for a private consultation with an ophthalmologist, a full eye examination including eye inspection, eye motility, red reflex, Hirschberg and pupillary reflexes.

VA is conducted for the first time at age 36-months by family practitioners, nurses and midwives working with family practitioners. This is then repeated at 42-months if failed. The criteria defined for a fail is VA less than 0.5 decimal (0.3 logMAR, 6/12 Snellen) for each eye or a difference of 2 lines between both eyes. The LEA logMAR symbol test is used. In the event of one failed VA measurement, or two failed attempts if inconclusive tests or insufficient cooperation of the child, the child will be referred for diagnostic testing.

There are plans to extend vision screening of this age group to schools, which will also involve VA testing.

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

	Paediatrician	Ophthalmologist	GP
Preterm babies	✓	✓	✓
0 to 3 months	✓	✓	✓
3 to 36 months	✓	✓	✓
3 to 7 years	✓	✓	✓

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

	EI	EM	RR	Hir	RE	PR	VA
Preterm babies	✓	×	✓	✓	✓	✓	×
0 to 3 months	✓	×	✓	✓	×	✓	×
3 to 36 months	✓	✓	✓	✓	×	✓	×
3 to 7 years	✓	✓	✓	✓	×	✓	✓

Key:

EI: Eye inspection; EM: Eye motility; RR: Red reflex testing; Hir: Hirschberg; RE: Retinal examination; PR: Pupillary reflexes; VA: Visual Acuity measurement

Table 3: Location of vision screening for each age group

	Child Health Care Centre	Hospital	Private clinic	GP office	Paediatricians office
Preterm babies	×	✓	×	✓	✓
0 to 3 months	✓	×	×	✓	✓
3 to 36 months	×	×	×	✓	✓
3 to 7 years	×	✓	×	×	×