BIOS VISION SCREENING AUDIT:

Academic Year 2017-2018

**Abbreviations**

**True +ve** – True Positive

**False +ve** – False Positive

**VS** – Vision Screener

**KCLT** – Keeler Crowded LogMAR Test

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**Paolo Mazzone**

Research Assistant

Health Economics and Decision Science

ScHARR  
University of Sheffield

**Dr Helen Griffiths**

Senior Lecturer in Orthoptics

Division of Ophthalmology & Orthoptics

Health Sciences School  
University of Sheffield

**Dr Jill Carlton**

Senior Research Fellow

Health Economics and Decision Science

ScHARR  
University of Sheffield

For BIOS Vision Screening Clinical Advisory Group



**OA** – Orthoptic Assessment

**VA** – Visual Acuity

**HES** – Hospital Eye Service

**HS** – High Street Optometrist

**CT** – Cover Test

**OM** – Ocular Movements

**BV** – Assessment of Binocular Vision

**F & M** - Fundus and Media examination

**Cyclo** - cycloplegic

**KPI** - Key performance indicators

**Glossary of Terms**

**True Positive (True +ve):** This is the number of children confirmed at diagnostic testing as having a visual defect (NB: see Figure 1)

**False Positive (False +ve):** This is the number of children confirmed at diagnostic testing as having no visual defect

**Professional:** The professional who undertakes the screening

**Pass criteria:** The pass criteria used in each area to determine that no referral is required

**Referral pathway:** The area's care pathway for children who fail the screening

**Eye exam:** The type of eye examination the child receives having failed the screening

**Management criteria:** The criteria used to determine the treatment / management

**Referral reason:** The reason for failing the screening test and referral to diagnostic pathway

**Mean wait:** The mean waiting time (in weeks) to be seen for the diagnostic eye examination

**Outcome:** The number of children in each category for the *initial* outcome of the eye exam, i.e. the outcome of the first diagnostic testing having failed the screening

**Diagnosis:** The number of children in each of the defined diagnostic categories based on the *initial* *outcome*

**Contents**

[**Abstract** 3](#_Toc5267934)

[**Background** 5](#_Toc5267935)

[**Methods** 7](#_Toc5267936)

[**Results of Site Data** 9](#_Toc5267937)

[**Results of Screening Data** 13](#_Toc5267938)

[**Discussion** 27](#_Toc5267939)

[**Conclusion** 31](#_Toc5267940)

[**References** 32](#_Toc5267941)

[**Appendix 1: Guidance for completion of data submission** 33](#_Toc5267942)

[**Appendix 2: BIOS recommended Vision Screening monitoring report** 36](#_Toc5267944)

**BIOS Vision Screening Audit: Academic Year 2016-2017**

# **Abstract**

***Aim:*** This audit utilises data submitted by Head Orthoptists to the British and Irish Orthoptic Society (BIOS). The aim is to describe vision screening practices across the United Kingdom (UK) for the academic year 2017-2018, compare the findings to the previous audits for academic years 2015-2016 and 2016-2017, and to provide evidence for future decision-making.

***Method:*** An Excel spreadsheet and guidance for completion was sent to 204 Orthoptic Heads of Service for submission in March 2019**.**Submitted data was integrated and the information was analysed to identify types of provision and outcomes across sites.

***Results:*** Twenty-eight sites (13.7%) responded to the data request, or these twenty-seven provided basic site data including consent policy and age at which tests are performed; a decrease from the previous academic years 2015-2016 (n=52 sites) and 2016-2017 (n=50 sites). Twenty-seven sites provided data on which professional administered screening, the test(s) used and the pass criteria adopted. These twenty-seven sites provided data regarding the referral pathway and twenty-five sites provided data on diagnostic examination and management criteria. Twenty-five sites provided data regarding the number of children screened (n=114,831), of which fifteen sites provided complete ‘accurate’ data on the number of children who failed screening (n=7,060 out of 65,959 screened). These twenty-five sites provided ‘accurate’ data on the number of children who attended their diagnostic follow-up (n=8,569). Eleven sites (n=4,645 children seen) provided data on initial outcomes of the eye examination and sixteen sites (n=2,366 children seen) provided diagnostic test data. The mean coverage increased to 98.3% (2016-2017=93%, 2015-16 =89%). True +ve rates were difficult to compare for each profession delivering screening, because of small numbers of submission with varied practice of test used, referral criteria and number of screens offered to each child.

Mean True +ve rates where a second screen was provided in school for children with borderline fail VA were 90% compared to a mean of 71% in sites where no 2nd screen was performed. Improved True +ve rates were also evident in sites who provided a second screen if the child was unable to perform the test. In both instances data relating to the second screening outcomes were limited and require further analysis.

***Conclusions:*** This audit concludes that many screening services do not have reliable methods to collect data to assess the effectiveness of the programme. A more effective method for collecting data and consistency in reporting is required to allow comparison and benchmarking of services. Without this, it is not possible to definitively conclude the effectiveness of vision screening, whether the professional delivering screening and type of vision screener training influences True +ve rates. The current limited data suggests that a second screen of children with borderline fail results or unable to perform the test reduces false positive referrals; cost-benefit analysis is required. The implications of these points are discussed.

# **Background**

The British and Irish Orthoptic Society (BIOS) is working to improve equity in the commissioning process for Vision Screening across the UK and Ireland. In some areas no service is commissioned whereas in other areas commissioned services are variable regarding personnel screening, consent procedures used, tests used, referral criteria and the referral diagnostic pathway.

Literature has shown that age-appropriate vision screening is a cost-efficient and clinically effective practice (Tailor et al, 2016). Screening in school is associated with reduced prevalence of amblyopia (Solebo, Cumberland & Rahi, 2014). Early screening has the potential to allow for better outcomes and orthoptist-led screening is suggested to be more accurate in a school age population, than non-specialist or lay screening (Hu et al, 2012). There is a body of research (e.g. Toufeeq & Oram, 2014; Hall and Elliman, 2003) recommending that vision screening for reduced vision be performed by orthoptists, or led by orthoptists between the ages of 4 and 5 years; a recommendation supported by the UK National Screening Committee (NSC) and BIOS. There is no robust research to support any other vision screening in childhood.

There is a lack of adherence to NSC recommendations by Vision Screening services. In October 2017 Public Health England (PHE) guidance was published (PHE, 2017) to aid Local Authorities in the commissioning and delivery of services. PHE utilised current literature to develop these evidence-based recommendations to promote standardised delivery of vision screening practices across the UK. The guidance provides explicit specification, training and pathway protocols; standards are still awaiting final approval and publication. The effect of this guidance will need to be evaluated but will take at least another two years before any changes in data outcomes can be expected.

BIOS is working to ensure that the specification and commissioning of Vision Screening contracts occur in a consistent way and deliver on NSC recommendations. Orthoptists are also working with the Governments in Scotland, Wales and Northern Ireland to achieve this standardisation.

The current 2017-2018 audit seeks to identify the current vision screening practice across the UK and Ireland, identify any changes from the previous year, allow benchmarking of services and provide evidence to allow decisions to be made regarding best practice for future commissioning.

# **Methods**

Data from local vision screening programmes were requested from Orthoptic Heads of Service via the BIOS email account for the academic year 2017-2018. The email was sent on 3rd February 2019 for submission by 3rd March 2019. The email request included an Excel spreadsheet and guidance to complete the data submission process. It included requests for data on two specific categories; site information and screening outcome data. The full list of data requested is provided in Appendix 1. The deadline was extended to 31st March 2019.

Two hundred and four sites were identified across the UK and Ireland, 29 (14.2%) of those sites provided initial data.Data was analysed for inclusion in ‘screening outcome data’ reporting by assessing ‘accuracy’ using four criteria, namely:

* Pass/Fail: The number of children who passed and failed screening must equate to the number of children who were actually screened.
* Referral Reasons: The number of referral reasons must equate to the number of children who failed screening.
* Initial Outcomes: The number of initial outcomes must equate to the number of children seen, after referral from diagnostic testing.
* True +ve /False +ve: The sum of True +ve and False +ve must equate to the number of children seen, after referral to diagnostic testing.

Sites were excluded on an individual basis, only if they provided inaccurate data at each point. For example, a site could be excluded for not providing ‘accurate’ referral reasons data, but could still be included in the initial outcomes and True +ve/False +ve analysis – if the data at these points was deemed ‘accurate’. In total two sites were removed from the screening outcome data analysis for not providing information pertaining to the number of children screened. Twenty-six sites remained for further analysis. The purpose of vision screening is to detect cases of reduced vision, in most cases due to amblyopia related to uncorrected refractive error and hence the need for glasses or presence of strabismus. However, variation still remains on how True +ve is measured. As with the previous report (2016-2017), three methods of measuring True +ve scores were implemented, detailed in Figure A.

**Figure A**

Method 1: True positive = Children not discharged following diagnostic assessment

* True +ve was calculated by obtaining the sum of those children who failed screening and were documented in categories 1,2,3,4,5,6,7 and 9 in the ‘initial outcome’ section, out of the total number of children seen (see Appendix 1 for categories).
* False +ve was calculated by obtaining the sum of children who failed screening and were documented in the ‘initial outcome’ category as 8 out of the total number of children seen.

Method 2: True positive = All with reduced vision at diagnostic assessment & needing treatment

* True +ve was calculated by obtaining the sum of those children who failed screening and were documented in categories 1, 4, or 7 in the ‘initial outcome’ section out of the total number of children seen.
* False +ve was calculated by obtaining the sum of children who failed screening and were documented in the ‘initial outcome’ category as either 2, 3, 5, 6, 8, or 9 out of the total number of children seen.

Method 3: True positive = All children with reduced vision at diagnostic assessment

* True +ve was calculated by obtaining the sum of those children who failed screening and were documented in categories 1,3, 4 & 7 in the ‘initial outcome’ section out of the total number of children seen.
* False +ve was calculated by obtaining the sum of children who failed screening and were documented in the ‘initial outcome’ category as either 2, 5, 6, 8, or 9 out of the total number of children seen.

Screening outcome data was analysed for each site and mean site data was subsequently calculated with ranges shown. The number of children (n) included in each analysis is detailed to allow for interpretation of data to be in context of the sample size. Total mean values based on all children combined from all sites was also analysed. Statistical analysis was not possible due to limited data.

# **Results of Site Data**

Twenty-eight sites responded, of these, twenty-seven sites provided site data (n=107,931 children screened). One site provided site data only and therefore the number of children screened in that area is unknown. Therefore, in the following tables, although the number of sites that carried out screening is accurate, the value shown for number of children screened is not the true total, but gives an indication of the scale of numbers involved in each process.

**The area specific consent policy:**

|  |  |  |  |
| --- | --- | --- | --- |
| Table 1 | Opt-out | Opt-in | Overall |
| Number of Sites | 26 | 1 | 27 |
| Number of Children | 107,931 | unknown | 107,931 |

**The age at which screening was delivered:**

*Other was detailed as aged 40-44 months of age.*

|  |  |  |  |
| --- | --- | --- | --- |
| Table 2 | 4-5 years | Other | Overall |
| Number of Sites | 26 | 1 | 27 |
| Number of Children | 107,931 | unknown | 107,931 |

**The professional by whom screening was delivered:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 3 | 1 | 2 | 3 | 4 | Overall |
| Number of Sites | 10 | 11 | 6 | 0 | 27 |
| Number of Children | 46,789 | 47,465 | 13,677 | 0 | 107,931 |

*1: Orthoptist; 2: Vision Screener (VS) trained by Orthoptist BIOS package; 3: VS trained by Orthoptist local package; 4: VS not trained by Orthoptist*

**The test/s used in the screening process:**

Twenty-seven sites submitted information in response to this question.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 4 | KCLT only | KCLT & OA | Other VA test | Other VA test & OA | Overall |
| Number of Sites | 17 | 5 | 5 | 0 | 27 |
| Number of Children | 65,885 | 23,131 | 18,915 | 0 | 107,931 |

*KCLT = Keeler crowded logMAR test, OA = Orthoptic Assessment, VA = visual acuity*

**The pass criteria adopted:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 5 | 0.200 each eye | 0.200 each eye & orthoptic test(s) | Other | Overall |
| Number of Sites | 19 | 4 | 4 | 27 |
| Number of Children | 69,388 | 18,461 | 20,132 | 107,931 |

**Second screening offered if unable to test**:

*One site was removed for not providing information.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 6 | Yes | No | Other | Overall |
| Number of Sites | 9 | 15 | 2 | 26 |
| Number of Children | 45,604 | 50,123 | 8,542 | 104,269 |

**Second screening offered if borderline VA:**

*One site was removed for not providing information.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7 | Yes | No | Other | Overall |
| Number of Sites | 6 | 20 | 0 | 26 |
| Number of Children | 35,411 | 68,858 | 0 | 104,269 |

**The referral pathway for children who fail the screening:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 8 | HES service | HSO | HES or HSO | Overall |
| Number of Sites | 17 | 1 | 9 | 27 |
| Number of Children | 70,552 | 5,567 | 31,812 | 107,931 |

*HES = Hospital Eye Service only, HS = High Street Optometrist, HES or HS = Hospital Eye Service or High Street Optometrist based on criteria*

**The eye examination used for children who have failed:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 9 | VA, CT, OM, BV, cyclo refraction, F&M | Testing determined by eye-care professional | Other\* | Overall |
| Number of Sites | 18 | 7 | 2 | 27 |
| Number of Children | 67,422 | 31,690 | 8,819 | 107,931 |

*VA = visual acuity, CT = Cover test, OM = ocular movements, BV = Assessment of binocular vision, cyclo refraction = cycloplegic refraction, F & M = fundus and media examination*

*\*‘Other’ was described as:*

* *Children with no squint but who's VA is not worse than 0.675 are referred to the outside optometrists and are requested to do a cycloplegic refraction. Children referred to HES are triaged appropriately to the orthoptist, optometrists or ophthalmology and that professional performs what tests are appropriate.*
* *Exactly as per option 1, but using Sonksen LogMAR test instead of Keeler.*

**The criteria used to determine the treatment / management of the child:**

*Three sites were removed for not providing information.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 10 | Evidence-based | Opinion / clinical judgement | Other\* | Overall |
| Number of Sites | 15 | 8 | 2 | 25 |
| Number of Children screened | 59,987 | 28,819 | 4,910 | 93716 |

*\*3 sites provided information detailing the use of ‘other’ treatment/management criteria. These were explained as a combination of evidence-based and opinion/clinical judgement; i.e. evidence based but if borderline clinical judgement*

# **Results of Screening Data**

**Coverage of the screening**

Data was requested on the number of children eligible to be screened and the number of those children actually screened. Twenty-five sites provided data on the number of eligible children (n=116,854) and the number of children screened (n=114,831); this allowed for a calculation of the mean coverage and range (%) across these twenty-six sites, shown in Table 11.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 11 | Number Eligible | Number Screened | Mean Coverage (%) | Site Range (%) |
| Number of Sites | 25 |  |  |  |
| Number of Children | 116,854 | 114,831 | 98.3 | 87.5 - 99.8 |

* Mean site coverage for academic year 2015/16: 89% - Range: 33% to 100%.
* Mean site coverage for academic year 2016/17: 93% - Range: 69.7% to 99.8%

**Referral Rate**

Data was requested on the number of children who passed and failed the screening.

Referral rate was calculated by the percentage of children who failed screening out of the number screened. Data was available from 20 sites (82,979 children screened, of which 11,438 failed) and categorised based on professional delivering the screening. Seven sites were removed for not providing ‘accurate’ data at this stage and one site was excluded for not providing information on what professional conducts screening.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 12 | 1 | 2 | 3 | 4 | A\* | B\* | Overall |
| Number of Sites | 9 | 5 | 5 | 0 | 0 | 0 | 28 |
| Number screened | 40,250 | 22,152 | 13,677 | 0 | 0 | 0 | 76,079 |
| Number referred | 4,844 | 3,356 | 1,734 | 0 | 0 | 0 | 9,934 |
| Total % children | 12.0 | 15.2 | 13 | 0 | 0 | 0 | 13.1 |
| Site Mean (%) | 12.5 | 14.6 | 12 | n/a | n/a | n/a | 12.9 |
| Site Range (%) | 3 - 25 | 11-22 | 7 - 20 | n/a | n/a | n/a | 3 - 25 |

*1= Orthoptist; 2= VS trained by Orthoptist BIOS package; 3= VS trained by Orthoptist local package; 4=VS not trained by Orthoptist; A\*= 1 and 2 - “Undertaken by both”; B\* - “Part of BIOS package used: lectures delivered, but competencies not assessed”*

* Mean overall site referral rate in 2015/16 academic year was 12%; Range was 4% - 24%
* Mean overall site referral rate in 2016/17 was 14%; Range was 3% - 30%.

**Reason for the referral / fail**

Data was available from 15 sites including 65,959 children screened, of which 7,060 failed. Eleven sites were removed for not providing ‘accurate’ data at this stage. A further one site was removed for not providing information on the number of children screened.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 13 | Failed VA test | Failed VA & OA | Failed OA | Referred poor cooperation | Overall |
| Number of Children Failed | 6,403 | 314 | 84 | 259 | 7,060 |
| Total (%) | 90.69 | 4.45 | 1.19 | 3.67 | 100 |
| Site Mean (%) | 86.25 | 10.12 | 0.96 | 2.67 | 100 |
| Site Range (%) | 0 – 100 | 0 – 100 | 0 – 6.58 | 0 – 12.40 | 0-100 |

**Attendance for eye examination**

Data was requested on the number of children referred from screening that attended the full diagnostic eye examination. Data was available from 25 sites (n=8,569 children seen).

* Mean attendance was 69%, range was 16.4% to 94.8%
* Mean attendance in 2016-2017 was 71%, range 27% to 95%
* Sites were contacted to determine any specific reasons for low attendance; external factors were described such as setting/location where diagnostic testing was offered (e.g. in a school, clinic, hospital) with difficult access affecting the ease for parents and children to attend the appointment.

**Mean Age at Diagnostic Test**

Data was available from 19 sites (n=6,531 children seen).

|  |  |  |
| --- | --- | --- |
| Table 14 | Screened at 4-5 years | Screened at ‘Other’ |
| Number of sites | 16 | 3 |
| Number seen | 5,934 | 597 |
| Mean age | 55.1 months | 63.8 months |

* Mean age 56.1 months, range 52-67 months
* Mean age 2016/2017 was 61.0 months, range from 42 to 70 months.

**Waiting time from Screen fail to diagnostic appointment**

Data was available from 24 sites (n=8,252 children seen). There is no data concerning waiting times for those children referred to high-street opticians; only for those referred to orthoptic led HES and HES & own optician based on set criteria.

* Mean wait 2017/2018: 8.6 weeks, range 2.4 to 37.5 weeks
* Mean wait 2016/2017: 7.7 weeks, range 2.9 to 14.0 weeks.

**Initial Outcome of the eye examination:**

Data was available from 11 sites (n=2,366 children seen):

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 15 | Initial Outcome of eye examination | | | | | | | |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Number of children | 1,424 | 106 | 129 | 3 | 0 | 5 | 28 | 625 | 46 |
| Mean (%) | 60.2 | 4.5 | 5.5 | 0.1 | 0.0 | 0.2 | 1.2 | 26.4 | 1.9 |

*1) Glasses prescribed; 2) Borderline prescription, no glasses given yet, but review; 3) Borderline VA, no glasses required but review; 4) Occlusion given; 5) Orthoptic exercises; 6) Ophthalmic pathology with normal VA; 7) Ophthalmic pathology with reduced VA; 8) Discharged as no defect; 9) Other*

**Number seen by an Ophthalmologist**

Data was requested on the number of children who required an ophthalmic opinion.

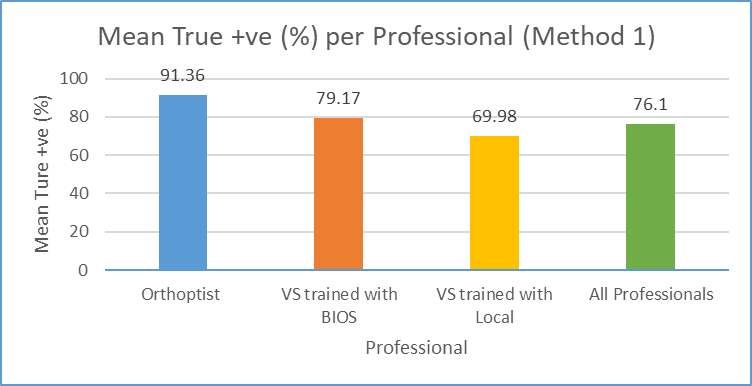
Data was available from 22 sites. Of 6,940 children attending for diagnostic testing within Hospital Eye services, 1,011 (Mean: 10.1%; Range: 0.0% - 90.4%) received an ophthalmic opinion.

**Number of True positives (*Method 1: see Figure A)***

Data was available from 11 sites (n=2,366 children seen), whereby full representation of children who had failed screening was evident and accounted for in the initial outcome section. Data was requested on the number of children confirmed as having a visual defect, this was calculated using Initial Outcomes categories 1-6 & 8 and categorised based on professional, none of these sites used the services of vision screeners not trained by an orthoptist:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 16 | Orthoptist screening | VS trained with BIOS | VS trained with Local | Overall |
| Number of Sites | 1 | 5 | 5 | 11 |
| Number of Children seen | 162 | 996 | 1,208 | 2,366 |
| Number of True Positives | 148 | 778 | 815 | 1,741 |
| Mean (%) | 91.4 | 79.2 | 70.9 | 76.1 |
| Range (%) | n/a | 66 – 99 | 38 – 87 | 38 – 99 |

**Figure 1:**

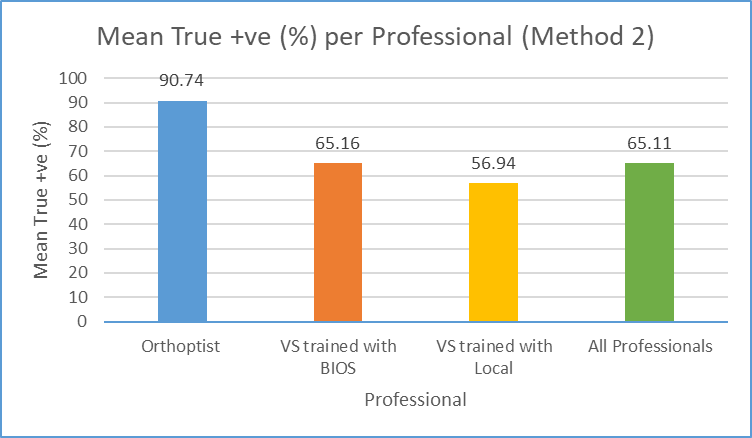
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**Number of True positives (*Method 2: see Figure A)***

Data was requested on the number of children confirmed as having a visual defect related to the target condition: this is the total number of children in the **initial** outcome categories 1 & 4 and categorised based on professional, none of these sites used the services of vision screeners not trained by an orthoptist:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 17 | Orthoptist screening | VS Trained with BIOS | VS trained with Local | Overall |
| Number of Sites | 1 | 5 | 5 | 11 |
| Number of Children seen | 162 | 996 | 1,208 | 2,366 |
| Number of True Positives | 147 | 633 | 675 | 1,455 |
| Mean (%) | 90.7 | 65.2 | 59.9 | 65.1 |
| Range (%) | n/a | 51 – 90 | 37 – 76 | 37 – 90 |

**Figure 2:**

****

**Number of True positives (*Method 3: see Figure A)***

Data was used for determination of True +ve with just the number of children confirmed as having a reduced vision on diagnostic testing, this is the total number of children in the **initial** outcome categories 1, 3 & 4 and categorised based on professional, none of these sites used the services of vision screeners not trained by an orthoptist:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 18 | Orthoptist screening | VS Trained with BIOS | VS trained with Local | Overall |
| Number of Sites | 1 | 5 | 5 | 11 |
| Number of Children seen | 162 | 996 | 1,208 | 2,366 |
| Number of True Positives | 148 | 697 | 739 | 1,584 |
| Mean (%) | 91.4 | 70.7 | 64.1 | 69.6 |
| Range (%) | n/a | 59 – 97 | 38 – 78 | 38 – 97 |

**Figure 3:**

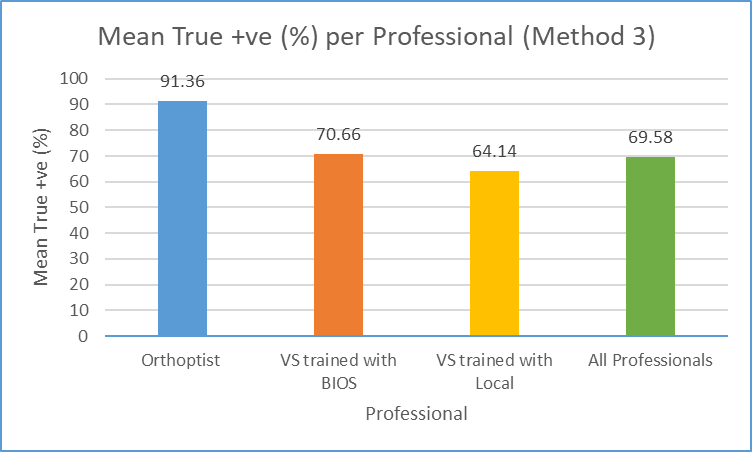
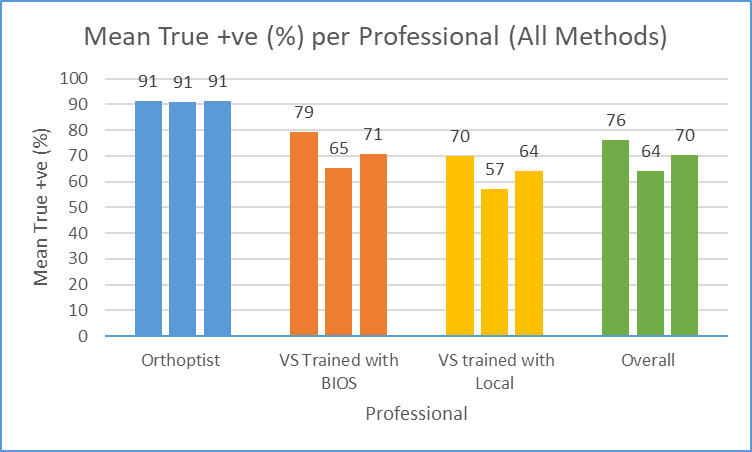
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Table 19 compares the overall mean True +ve (and range) for each professional category based on True +ve calculation methods 1, 2, or 3.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 19 | Mean True +ve  Method 1 (76%\*) | Mean True +ve  Method 2 (65%\*) | Mean True +ve  Method 3 (70%\*) |
| Orthoptist screening | 91.4 | 90.7 | 91.4 |
| VS Trained with BIOS | 79.2 (66 - 99) | 65.2 (51-90) | 70.7 (59-97) |
| VS trained with Local | 70.0 (38-87) | 56.9 (37-76) | 64.1 (38-78) |

*\* Mean % True +ve for all professionals*

**Figure 4:**



**Effect of test on True +ve** (n=2,366 children): Based on True +ve calculation Method 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 21 | KCLT only | KCLT and OA | Other VA test\* | Other VA test and OA | Overall |
| Number of sites | 7 | 0 | 4 | 0 | 11 |
| Number of children seen | 1,305 | 0 | 1,061 | 0 | 2,366 |
| Mean (%) True Positives | 77.8 | 0 | 73.2 | 0 | 76.1 |
| Range (%) True Positives | 61 – 99 | n/a | 38 – 91 | n/a | 38 – 99 |

*\*Other VA tests used were stated as Thomson Vision Screener, Sonksen LogMAR test and Sonksen crowded LogMAR.*

Table 21 does not take into account a potential confounding variable, i.e. professional administering the test. Data in Table 22 considers these results in relation to the professional administering the test.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 22 | Orthoptist | VS trained BIOS | VS trained Local | VS not trained by Orthoptist | Overall |
| KCLT only | 0 | 5 | 2 | 0 | 7 |
| KCLT OA | 0 | 0 | 0 | 0 | 0 |
| Other VA test | 1 | 0 | 3 | 0 | 4 |
| Other VA test & OA | 0 | 0 | 0 | 0 | 0 |
| Overall | 1 | 5 | 5 | 0 | 11 |

True+ve regarding test used was explored based on professional administering the test. This is documented in tables 23-26.

**Orthoptist**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 23 | KCLT only | KCLT and OA | Other VA test | Other VA test and OA |
| Number of sites | 0 | 0 | 1 | n/a |
| Number of children seen | 0 | 0 | 162 | n/a |
| Mean (%) True Positives | n/a | n/a | 91.4 | n/a |
| Range (%) True Positives | n/a | n/a | n/a | n/a |

**VS Trained by an Orthoptist using BIOS package**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 24 | KCLT only | KCLT and OA | Other VA test | Other VA test and OA |
| Number of sites | 5 | 0 | 0 | 0 |
| Number of children seen | 996 | n/a | n/a | n/a |
| Mean (%) True Positives | 79.2 | n/a | n/a | n/a |
| Range (%) True Positives | 66 – 99 | n/a | n/a | n/a |

**VS Trained by an Orthoptist using Local package**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 25 | KCLT only | KCLT and OA | Other VA test | Other VA test and OA |
| Number of sites | 2 | 0 | 3 | 0 |
| Number of children seen | 309 | n/a | 899 | n/a |
| Mean (%) True Positives | 74.3 | n/a | 67.1 | n/a |
| Range (%) True Positives | 61 – 87 | n/a | 38 – 84 | n/a |

**Effect of pass criteria on (Method 1) True +ve** (n=2,366 children seen)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 27 | 0.200 each eye | 0.200 & OA | Other | Overall |
| Number of sites | 9 | 0 | 2 | 11 |
| Number seen | 1,876 | 0 | 490 | 2,366 |
| Mean True +ve (%) | 78.7 | n/a | 64.4 | 76.1 |
| Range True +ve (%) | 61 – 99 | n/a | 38 – 91 | 38 – 99 |

Table 27 does not take into account a potential confounding variable, i.e. professional administering the test. Therefore, the above table was broken down to show information regarding professional administering the test. The results are shown in Tables 28.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 28 | Orthoptist | VS BIOS | VS Local | Overall |
| 0.200 each eye | 0 | 5 | 4 | 9 |
| 0.200 & other OA | 0 | 0 | 0 | 0 |
| Other | 1 | 0 | 1 | 2 |
| Overall | 1 | 5 | 5 | 11 |

True +ve regarding pass criteria was explored based on professional administering the test. This is documented in tables 29-32.

**Orthoptist**

|  |  |  |  |
| --- | --- | --- | --- |
| Table 29 | 0.200 each eye | 0.200 & OA | Other\* |
| Number of sites | 0 | 0 | 1 |
| Number of children seen | 0 | 0 | 162 |
| Mean (%) True Positives | n/a | n/a | 91.4 |
| Range (%) True Positives | n/a | n/a | n/a |

*\*Other pass criteria specified as 0.150 in each eye.*

**VS Trained by an Orthoptist using BIOS package**

|  |  |  |  |
| --- | --- | --- | --- |
| Table 30 | 0.200 each eye | 0.200 & OA | Other |
| Number of sites | 5 | 0 | 0 |
| Number of children seen | 996 | n/a | n/a |
| Mean (%) True Positives | 79.2 | n/a | n/a |
| Range (%) True Positives | 66 – 99 | n/a | n/a |

**VS Trained by an Orthoptist using Local package**

|  |  |  |  |
| --- | --- | --- | --- |
| Table 31 | 0.200 each eye | 0.200 & OA | Other\* |
| Number of sites | 4 | 0 | 1 |
| Number of children seen | 880 | n/a | 328 |
| Mean (%) True Positives | 78.1 | n/a | 37.5 |
| Range (%) True Positives | 61 – 81.7 | n/a | n/a |

*\*Other pass criteria specified as 0.150 in each eye.*

**Effect of Second Screen**

Two questions were added this year to determine any differences in offering a second screen for either those children with poor co-operation and/or children who are borderline fail on the VA test. Tables 6 shows that of 26 sites providing information, 9 offered second screening to children who were unable to perform the test, of these five submitted ‘accurate’ data. Fifteen sites reported that they did not offer a second screen for children who were unable to complete the test, of which eleven site submitted ‘accurate’ data. Their outcomes are shown in Table 33.

.

|  |  |  |
| --- | --- | --- |
| Table 33 | 2nd screen co-op | No 2nd screen co-op |
| Number of sites | 5 | 11 |
| Number of children seen | 36,841 | 40,217 |
| Number of children 2 screens | 516 | 0 |
| Mean (%) True Positives | 77.2 | 71.0 |
| Range (%) True Positives | 69.3 – 91.4 | 49.7 - 87.7 |

Six sites (Table 7) reported that they offered a second screen for children where the VA was borderline fail. Of these, three submitted ‘accurate’ data. Twenty sites reported that they did not offer a second screen for children who were borderline fail on the screening test, of which fourteen site submitted ‘accurate’ complete data. Their outcomes are shown in Table 34.

|  |  |  |
| --- | --- | --- |
| Table 34 | 2nd screen borderline | No 2nd screen |
| Number of sites | 3 | 14 |
| Number of children screened | 13,465 | 47,682 |
| Number of children 2 screens | 203 | 0 |
| Number of children referred | 1,244 | 6,300 |
| % of children screened referred | 9.2 | 13.2 |
| Mean (%) True Positives | 90.3 | 71.4 |
| Range (%) True Positives | 87.3 - 92.2 | 49.7 - 94.3 |

Mean True +ve rates where a second screen was provided in school for children with borderline fail VA were 90% compared to a mean of 71% in sites where no 2nd screen was performed. Improved True +ve rates were also evident in sites who provided a second screen in school where the child was unable to perform the test, mean 77% compared to the mean for sites providing no second screen of 71% True +ve.

**Initial diagnosis**

Data was requested on the number of children in each of the following diagnostic categories based on the ***initial* *outcome****.* None of the participating sites provided complete data; i.e. the total number of Initial diagnoses did not equate to the number of children seen. Therefore, table 35 displays the data provided, but it is not clear if this is accurate or reliable. Reasons might be due to children being lost to follow-up, services not providing outcome data, or some children may have already been in the system and therefore the data is inflated.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 35 | | | |  | | | | |  | | | |
|  | 1 | 2 | 3 | | 4 | 5 | 6 | 7 | | 8 | 9 | Total |
| Number Children | 4237 | 118 | 426 | | 51 | 18 | 529 | 15 | | 46 | 389 | 5,829 |
| Mean % | 73 | 2 | 7 | | 1 | 0 | 9 | 0 | | 1 | 7 |  |

*1) Refractive error only*

*2) Manifest strabismus only[[1]](#footnote-1)*

*3) Manifest strabismus and refractive error*

*4) Ocular motility defect only*

*5) Poor convergence only*

*6) No confirmed abnormality, review as borderline/ poor coop*

*7) Ophthalmic pathology only*

*8) Ophthalmic pathology with reduced vision*

*9) Other – stated as: booked back for topography as irregular retinal reflex, refractive error and ocular motility defect, discharged as parent declined cyclopegic exam, Reason not documented, or nystagmus & ASD.*

# **Discussion**

**Number of submissions**

There has been a significant reduction in the number of sites providing data to contribute to the annual BIOS audit report of the current academic year (2017-2018). It is therefore difficult to make direct comparisons on uptake of recommended vision screening practices between the current academic year (2017-2018) and the previous two academic years. Any comparisons made are expressed with this caveat. Specific differences in key performance indicators and further audit data between academic years 2017-2018, 2016-2017 and 2015-2016 are detailed in Appendix 2. The number of site data sets received for academic year 2017-2018 has decreased to 28 sites from 50 sites in academic year 2016-2017 and 52 sites in academic year 2015-2016. This may be due to the later request for data submission (February for this report instead of October for the 2016-2017 report). Although this change was introduced as many reports were submitted late in the previous years due to difficulty collecting outcome data within five months of the end of the screening period.

**Age, consent, test and referral criteria implemented**

In the current academic year, 2017-2018, opt-out consent was implemented in 26 of the 27 sites (96%). The PHE guidance (2017) states that the consent method used should be decided by individual LAs, so variation may continue to occur. Twenty-six sites (93%) screened at 4-5 years, one site (3.5%) screened at 4-6 years and one site (3.5%) did not provide any information on this question. Eleven sites submitted data detailing that screening is conducted by a vision screener (VS) trained by an orthoptist using the BIOS package. This has decreased from 2015-2016 (n=15) and increased from 2016-2017 (n=9). The reduction this year is most likely due to the significant decrease in data submitted.

The number of sites submitting data who use Keeler Crowded logMAR test (KCLT) only (n=17), is 63% of submissions compared to 48% (n=27) in 2015-2016 and 46% (n=24) in 2016-2017. Five sites submitted data using a KCLT and orthoptic assessment (19%) compared to 8 (15%) in 2015-2016 and 7 (14%) in 2016-2017. The number of sites using the recommended pass criteria of 0.200 in each eye was 19 (70%) compared to 32 (64%) in the academic year 2015-2016 (62%) and 27 (54%) in 2016-2017. The number of sites using referral criteria of 0.225 or worse in each eye and/ or abnormal responses using other orthoptic tests is 4 (15%) compared to 8 submissions (15%) from academic year 2015-2016 and 5 (10%) in 2016-2017.

**Second screen**

Two questions were added this year to determine any differences in offering a second screen for either those children with poor co-operation and/or children who are borderline fail on the VA test. Tables 6 and 7 show that 9 of 26 sites providing information, offered second screening to children who were unable to perform the test and 6 sites provided a second screen for those with borderline VA. Improved True +ve rates were evident in sites who provided a second screen in both circumstances. Although the number of submissions limits the interpretation of this data, a second screen system appears to show benefits in terms of reduced False +ves. Further analysis is required to determine the potential cost-savings in the diagnostic pathway compared to the additional screening costs and the impact of reduced anxiety and costs for parents where a second screen system is implemented.

**The diagnostic pathway**

Follow-up of children within the diagnostic pathway was variable, for instance, Table 9 shows that almost a third of sites vary the diagnostic assessments dependent on the health-care professional opinion. Further correspondence with two of these sites reported for example that cycloplegic refraction was not always performed at the diagnostic assessment before discharge. Another variable was the number of children seen by an ophthalmologist recorded as 1011 (11%) out of 6,940 attending diagnostic testing within the Hospital Eye Service (range of 0-90.4%) comparing similarly (0.3%-85.2%) to data collected from the 2016-2017 academic year. These findings highlight differences in the diagnostic pathways across sites. It could indicate a disparity of resources across sites and emphasises the need for a national guideline approach to vision screening practices in relation to the diagnostic pathway to ensure the most cost-effective services are commissioned. The Royal College of Ophthalmologists diagnostic pathway (2017) is included in the Public Health England (PHE) guidance published in October 2017 (PHE, 2017) which may improve standardisation.

**Coverage**

In total, for academic year 2017-2018, of 116,854 eligible children, 114,831 were screened (total mean=98.3%; Range=87.5%-99.8%). This is an increase from academic year 2016-2017 (total mean=93%; Range=69.7%-99.8%). The one site using opt-in consent did not submit data to allow calculation of coverage. It should be noted therefore that using opt-out consent, the range of coverage was 87.5 to 99.8% which may reflect population or geographical differences. Those with lower coverage rates could consider strategies to increase this towards the mean of 98%.

**Definition of True positive**

Three methods were applied to determine True +ve percentages, shown in Figure A of the methods section. It could be considered that as the children in ‘initial outcome categories’ 2, 3, 5 and 6 have 0.02 VA or better, have no other refractive findings, or abnormality relating to the target conditions, they are False +ves. Children in category 9 are not defined and therefore pose a problem for calculation of True +ves. The results highlight the need for clear definitions of a True +ve and what the most effective practice is when considering children for review. For instance, Table 15 shows the number of children out of 2,366 referred from 11 sites, that are considered to have subnormal vision but are offered no treatment (n=307, 13% of those referred) and the number of children categorised as borderline prescription, no glasses given, and kept on for review (n=177, 7% of those referred). This shows a number of children (20% of those referred) who have not been treated and continue within the Hospital Eye Service (HES) or monitoring in other community services. The clinical reasoning may be that it is important to detect and check these children as treatment may be required at a later date and they would otherwise be missed. A subsequent follow-up of the outcomes at the next visit would be important for this group. This may then allow more specific criteria to be defined for those requiring follow-up and those that could be discharged earlier.

It is understood that Method 1 (True positive = all children not discharged at the diagnostic assessment) is the currently used by most, so used in the discussion of True +ve scores below, however, Method 3 (True positive = all children with reduced vision at the diagnostic assessment) should be considered further in future guidance.

**Professional delivering screening**

The professional subgroup delivering the screening that presented with the highest True +ve (Method 1) were Orthoptists (91.4%). This was followed by VS trained by an Orthoptist using the BIOS package (Mean=79.2%; Range=66%-99%) and VS trained by an Orthoptist using a local package (Mean=70.0%; Range=38%-87%). There were no submissions this year for screening delivered by VS but not trained by an Orthoptist. These figures should be interpreted with care as only one Orthoptic delivered screening site, submitted complete and ‘accurate’ outcome data and is included here. This site operate a system of re-screening children (232/6097 screened; 3.8%) with borderline vision or who are unable to complete the test, on a second visit to school. Whilst this reduces the number of referrals and false positives it increases costs of the screening service. A cost and outcome analysis, of the two-screen model compared to diagnostic testing immediately following first fail, would be warranted. This Orthoptic delivered screening cannot therefore be directly compared to outcomes of non-orthoptist VS personnel (Table 19) who didn’t operate the second screening policy.

The benefit of VS receiving training from an Orthoptist was shown in data reported in the 2016-17 audit. Effects of recent (April 2019) further standardisation of VS training by Orthoptists, incorporating PHE resources (2017) and Learning for Health (LfH) e-learning modules and launched with BIOS in April 2019, should be evaluated in future.

It is evident from the number of sites submitting complete and accurate data, that systems to collect information are lacking. A number of factors contribute to this such as; local commissioning, varied referral routes - often outside of the provider/ LA governance, varied approach to administrative processes and use of different computer data collection systems. Provision of national standards by PHE, which are currently under consideration, may be needed to drive standardisation and development of effective systems to accurately capture this vital information. In the absence of robust outcome data, the effectiveness of Vision Screening for reduced vision cannot be determined.

# **Conclusion**

The number of sites participating in the 2017-2018 BIOS vision screening audit has decreased significantly from the previous academic year 2016-2017. The mean coverage from sites reported in 2017-18 is higher than in the previous academic years. Caution in interpreting this, and other comparisons in the report, is needed due to the reduced submission rate.

Offering a second screen for borderline fails and children who are unable to complete the test appears to increase True +ve rates; further reporting, analysis of all benefits/harms and detailed examination of cost-effectiveness are required.

Further investigation with a larger dataset is needed to clearly identify the effect of the Vision Screener personnel on True +ve scores. The possible effects of training received have been highlighted in this report, with standardised orthoptic training being essential to produce acceptable outcomes. Updated, standardised training has been introduced in 2019 and evaluation of this will be required.

The effects of carrying out a further report with a more comprehensive data set, or indeed not doing so, could have a significant impact on national screening recommendations. There is an urgent need for a more comprehensive data set in order to identify trends and make informed suggestions regarding vision screening practices. There is also a need for sites to have consistent definitions, methods of data collection and data submission. Planned publication of PHE Standards for Vision Screening and further development of these, should be a driver for standardisation in the process for providers and LAs.

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# **Appendix 1: Guidance for completion of data submission**

Site Information was requested to provide the basic information about the screening provided in each area. This included:

Area ID – the area’s ID from BIOS interactive maps

Area name - the area’s ID name from BIOS interactive maps

Contact email – the email address of the person submitting the data

Consent - the area’s consent policy:

1 = opt-out

2 = opt in

Age – the age at which children are screened in each area:

1 = age 4 – 5 years

2 = other

Professional – the professional who undertakes the screening:

1 = Orthoptist

2 = vision screener trained by Orthoptist with BIOS training package

3 = vision screener trained by Orthoptist with local training package

4 = vision screener not trained by Orthoptist

Test/s – the test/s are used in the screening:

1 = Keeler crowded logMAR vision test only

2 = Keeler crowded logMAR vision and Orthoptic assessment

3 = other VA test

4 = other VA test and orthoptic assessment

Pass criteria - the pass criteria used in each area:

1 = 0.200 each eye

2 = 0.200 each eye and other orthoptic test(s)

3 = other

Referral pathway - the area's care pathway for children who fail the screening:

1 = all fails referred to Orthoptic led HES service

2 = all fails referred to high street Optician

3 = referral to HES and own Optician based on set criteria

Eye exam - the type of eye exam the child receives having failed the screening:

1 = Assessment of vision (R+L) Keeler Crowded LogMAR, Assessment of Binocular vision and motility Cycloplegic (if required) refraction & fundus / media exam for every child referred

2 = testing required determined by eye care professional

3 = other

Management criteria - the criteria used to determine the treatment / management of the child:

1 = evidence-based criteria used to determine if visual deficit present i.e level of vision and refractive guidelines used.

2 = based on opinion / clinical judgement of individual professional

Screening data was requested from each area, this included:

* Number eligible – the number of children in the target age group to be screened in each area.
* Number tested - the number of eligible children actually screened.
* Passed – the number of children who passed the screening.
* Failed – the number of children who failed the screening and were referred.

Referral reason – the reason for the referral / fail and details about the number of children in each category:

1 = failed vision test

2 = failed vision test and orthoptic assessment

3 = failed orthoptic assessment only (i.e. any or all of the following CT, OM, BV test)

4 = referred as poor cooperation

Number seen – the number of children referred who attended for the eye exam

Mean age – the mean age in months of the children seen

Age range - the age range in months of these children

Mean Wait - the mean waiting time (in weeks) to be seen for the eye exam

Outcome - the number of children in each category for the *initial* outcome of the eye exam - the outcome of the first eye exam having failed the school screening:

1 = Glasses prescribed

2 = Borderline prescription, no glasses given yet, but review

3 = No glasses required but review as borderline / subnormal vision

4 = Occlusion only, no glasses given (*i.e. may rarely be given at initial visit as no glasses required, fundus exam normal and monocular sub-normal acuity due to manifest squint)*

5 = Orthoptic exercises

6 = Ophthalmic pathology with normal VA

7 = Ophthalmic pathology with reduced VA

8 = Discharged as no defect

9 = Other

Ophthalmologist – the number of children who required an ophthalmic opinion

Number of True positives – this is the number of children confirmed as having a visual defect – this is the total number of children in the *initial* outcome categories 1 and 4 described above.

Number of false positives – this is the number of children confirmed as having no clear visual defect – this is the total number of children in the *initial* outcome categories 2, 3, 5 and 6 described above.

Diagnosis - the number of children in each of the following diagnostic categories based on the *initial* *outcome -* this is the diagnosis based on the outcome of the first eye exam having failed the school screening:

1 = refractive error only

2 = manifest strabismus only (includes constant, intermittent and microtropia, eso and exo)

3 = manifest strabismus and refractive error

4 = ocular motility defect only

5 = poor convergence only

6 = no confirmed abnormality but review as poor cooperation, or borderline results

1. = ophthalmic pathology only
2. = Ophthalmic pathology with refractive error &/or strabismus
3. = other

# **Appendix 2**

**BIOS Recommended Vision Screening Monitoring**

On the basis of the data presented:

**BIOS Key Performance Indicators**

KPI 1: % of children who were screened

KPI 2: % of children screened who were referred for an eye examination

KPI 3: % of children referred who attended for an eye examination

KPI 4: % True-positive referral rate

|  |  |  |  |
| --- | --- | --- | --- |
|  | Academic Year 2015-2016 | Academic Year 2016-2017 | Academic Year 2017-2018 |
| **KPI 1** | 89% | 93% | 98% |
| **KPI 2** | 12% | 13% | 13% |
| **KPI 3** | 77% | 71% | 76% |
| **KPI 4** | 76% (Method 1)  58% (Method 2)  68% (Method 3) | 81% (Method 1)  61% (Method 2)  67% (Method 3) | 76% (Method 1)  65% (Method 2)  70% (Method 3) |

**BIOS Further Audit Data**

AD 1: Number of children aged 4 – 5 years to be screened (eligible population)

AD 2: Number of children aged 4 – 5 years who were screened

AD 3: Mean age (and range) of the children referred

AD 4: Mean waiting time (and range) for the full eye examination

AD 5: % prevalence of prescription of glasses

AD 6: % prevalence of manifest strabismus (constant, intermittent or micro)

AD 7: % of children who required an ophthalmic opinion

|  |  |  |  |
| --- | --- | --- | --- |
|  | Academic Year 2015-2016 | Academic Year 2016-2017 | Academic Year 2017-2018 |
| **AD 1** | 165,283 | 175,407 | 116,854 |
| **AD 2** | 147,488 (89%) | 162,868 (93%) | 114,831 |
| **AD 3** | 58 months | 60 months | 55 months |
| **AD 4** | 5.7 weeks | 7.7 weeks | 8.6 weeks |
| **AD 5** | 56% | 35% | 60.2% |
| **AD 6** | 7% | 13% | 9% |
| **AD 7** | 10% | 11% | 10% |

1. Includes constant, intermittent and microtropia, eso and exo deviations. [↑](#footnote-ref-1)