BIOS VISION SCREENING AUDIT:

Academic Year 2018-2019

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Kyle Yau
BMed Sci (Hons) Orthoptics

Dr Helen J 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

The University Of Sheffield.

Abbreviations

BV – Assessment of Binocular Vision

BIOS – British and Irish orthoptic Society

CAG - Clinical Advisory Group

CT – Cover Test

Cyclo - cycloplegic

False +ve – False Positive

F & M - Fundus and Media examination

HES – Hospital Eye Service

HS – High Street Optometrist

KCLT – Keeler Crowded LogMAR Test

KPI - Key performance indicators

LA – Local Authority

NSC – National Screening Committee

OA – Orthoptic Assessment

OM – Ocular Movements

PHE – Public Health England

True +ve – True Positive

VA – Visual Acuity

VS – Vision Screener

Background

Vision screening in school has long been regarded as an effective way to reduce the prevalence rate of amblyopia induced by strabismus, high refractive error or other causes (Vision in preschool study group, 2003, Solebo, Cumberland & Rahi, 2014, Tailor et al, 2016). Early vision screening can detect the presence of amblyopia whilst it can still be treated, therefore preventing serious permanent visual loss in an early stage of life (Powell and Hatt, 2009).

Despite the importance of early detection of amblyopia being indisputable, the format of vision screening varies. The UK National Screening Committee (NSC), based on available evidence (Hall and Elliman, 2003), recommended that children aged 4-5 should receive vision screening (UK NSC, 2019). In 2017, a service specification was published by Public Health England (PHE) to guide local authorities (LA) in commissioning vision screening services (PHE, 2017). The specification provided detailed guidance on the evidence-based practice in providing vision screening services. The PHE specification recommended that the service should be orthoptist led; children with best corrected VA less than 0.200 logMAR, measured by Keeler crowded logMAR test, should be referred. Despite the detailed guidance provided by PHE, the level of adherence of LA in commissioning vision screening has not yet been revealed.

The British and Irish Orthoptics Society (BIOS) Vision Screening Clinical Advisory Group (CAG) is working to improve the quality of vision screening and to ensure best practice across the country. Hence it is paramount to promote the importance of the PHE guideline and to investigate the potential effect it brings. In addition, the 2018-2019 vision screening audit aims at mapping out current practices of vision screening across the UK and Ireland, identify changes in practice from the previous year and the effect of various factors on the effectiveness of vision screening. The intention is for this audit can facilitate the benchmarking of services and provide evidence to aid orthoptists and LAs in making informed decisions regarding vision screening commissioning.

Method

Vision screening data was collected from orthoptic departments across the UK via email. An email, which included a spreadsheet with three worksheets, was sent from the BIOS email account to the head orthoptists. The spreadsheet contained items regarding site information, screening data and a worksheet with area code and name for each orthoptic department. Each orthoptic department were invited to fill in the first two worksheets and use the third worksheet to obtain the area code and name. A guidance document was also provided to explain the meaning of each requested data cell listed within the worksheet. The full list of required data items requested in the spreadsheet and the guidance document is provided in appendix 1. The original deadline of submission was 31st May, 2020, which was later extended to 30th September 2020 due to poor response rate, possibly related to the Covid-19 pandemic restrictions and effects of this on hospital departments.

Two hundred and four sites (n=204) were identified across the UK and Ireland, of which 49 (24.0%) returned the spreadsheet. Preliminary data was first screened by the authors, inaccurate data was rechecked with the corresponding sites and missing data was obtained where possible. Data was then screened for "accuracy" based on 4 criteria:

1. Pass/Fail: The number of children who passed and failed screening must equate to the number of children who were actually screened.
2. Referral Reasons: The number of referral reasons must equate to the number of children who failed screening.
3. Initial Outcomes: The number of initial outcomes must equate to the number of children seen, after referral from diagnostic testing.
4. 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.

Data was deemed accurate individually based on each criterion. For instance, if data for a site is accurate based on criterion 1 and was deemed inaccurate based on criterion 2, it can be included in the pass/fail rate analysis but not in the referral reason analysis. Data from all 49 sites were kept for further analysis of the complete, accurate data available. Screening data was then analysed for each site with mean site data and range provided.
Different from previous academic year reports, the method of measuring true positive value in this report is simplified into the following:

True positive = All children with reduced vision (worse than 0.2 logMAR) at diagnostic assessment.

- True +ve was calculated by obtaining the sum of those children who failed screening and in the 'initial outcome' section was documented in category 3 (*VA) worse than 0.2 – Treatment and/or follow-up*) out of the total number of children seen for diagnostic testing.
- False +ve was calculated by obtaining the sum of those children who failed screening and were documented in the 'initial outcome' section as categories 1 *(VA 0.2 or better, no abnormality detected – Discharge)* or 2 *(VA 0.2 or better, - Follow-up)* out of the total number of children seen for diagnostic testing.

Data of each site were then analysed with the means calculated. The range of the means were then obtained. Median was also calculated where appropriate, which is detailed in the results section. Due to the limitation of small sample size, statistical analysis, such as two sample t-test was only used where possible.

Results

i. Site data

All responded sites provided site data (n=49). In total 204,856 children were screened by all the sites combined. The distribution of the sites regarding how they conducted vision screening is shown in the following tables.

Table 1: Distribution of method of obtaining consent for vision screening

The area specific consent policy:		
	Number of sites (%)	*Number of children screened*
Opt out	45 (91)	190,108
Opt in	3 (6)	11,850
Both – varied within the area	1 (2)	2,898
Total	49	204,856

Table 2: Distribution of the age at which screening was delivered

The age at which screening was delivered:		
	Number of sites (%)	*Number of children screened*
4 – 5 years	48 (97)	196,202
Not reported	1 (2)	8,654
Total	49	204,856

Table 3: Distribution of the profession by whom screening was delivered

Professionals:	*Number of sites (%)*	*Number of children screened*
Orthoptist	20 (40)	67,190
Vision screener trained by orthoptist BIOS/PHE package	15 (30)	67,564
Vision screener trained by orthoptist - local package	11 (22)	45,449
Vision screener not trained by orthoptist	3 (6)	16,890
Total	49	204,856

Table 4: Distribution of the test/s used in the screening process among the sites

Tests used	*Number of sites (%)*	*Number of children screened*
Keeler crowded logMAR VA test only	26 (53)	10,8350
Keeler crowded logMAR VA test and orthoptic assessment	10 (20)	30,974
Other VA test	12 (24)	63,577
Other VA test and orthoptic assessment	1(2)	1,955
Total	49	204,856

Table 5: Pass criteria adopted by the sites

Pass criteria	*Number of sites (%)*	*Number of children screened*
0.200 each eye	29 (59)	123,709
0.200 each eye and other orthoptic tests	10 (20)	27,413
*Others**	10 (20)	53,734
Total	49	204,856

**Others included: 0.2 for Keeler logMAR 0.1 for Kays Crowded logMAR, 0.15 either eye, 0.1 right eye and left eye and < 0.100 interocular acuity difference between the eyes, 0.125 each eye, 0.150 either eye, 0.1 each eye and other orthoptic test*

Table 6: Distribution of second screening offered if unable to test

Second screening offered if unable to test	*Number of sites (%)*	*Number of children screened*
Yes, a second screen is performed	10 (20)	30,195
No, all referred immediately if they are unable to complete the test	34 (69)	163,545
*Other**	5 (10)	11,115
Total	49	204,855

* *Other included: Referred to community optometrist, offer a second screen if >3 children at that school or refer to shared care optometrists or orthoptics only, if there are 5 or more absents/ poor co-op otherwise "non-co-ops" are referred to HES, either second screen or referred immediately depending if able to return to the school.*

Table 7: Distribution of second screening offered if borderline VA

Second Screening if borderline VA	*Number of* sites (%)	*Number of children screened*
Yes	7 (14)	19,730
No, referred if borderline fail VA	42 (85)	185,126
Total	49	204,856

Table 8: Distribution of the referral pathway of the sites

Referral pathway	Number of sites (%)	*Number of children screened*
*All fails referred to orthoptic HES services**	31 (63)	136,689
All fails referred to high street optometrist	1 (2)	5,364
*Refer to high street optometrist or HES based on set criteria**	17 (35)	62,803
Total	49	204,856

**HES=Hospital eye service*

Table 9: Distribution of the diagnostic eye examination conducted for children who have failed screening

Eye exam		
	Number of sites (%)	*Number of children screened*
VA (R+L) Keeler Crowded logMAR, Binocular vision, motility, cyclo refraction, fundus/media	25 (51)	93,742
Testing determined by eye care profession	23 (47)	105,634
Other	1 (2)	5,480
Total	49	204,856

Table 10: Distribution of the criteria to determine treatment

Criteria to determine treatment		
	Number of sites	*Number of children screened*
Evidence based criteria level of VA/refractive error	25 (51)	91,963
Based on clinical judgement	15 (31)	62,161
Other	7 (14)	34,880
Unknown	1 (2)	2,786
Evidence based criteria VA/refractive error & based on clinical judgement	2 (4)	13,066
Total	49	204,856

Table 11: Distribution of compliance to Public Health England guidelines (Appendix 2)

Compliant to Public Health England guidelines		
	Number of sites	*Number of children screened*
Yes	20 (41)	119,021
No	28 (57)	79,434
Unknown	1 (2)	6,401
Total	49	204,856

ii. Results of screening data

Coverage of vision screening

Table 12 shows coverage of screening of all the sites that provided data. 5 sites were excluded due to missing data. Of the 44 sites included in the analysis, in total 184,481 children were screened. The mean coverage was 91.9% (Range 76%-100%). The mean site coverage and range for academic year 2016/17 & 2017/18 are listed below.

- Mean site coverage for academic year 2016/17: 93% - Range: 69.7% to 99.8%
- Mean site coverage for academic year 2017/18: 98% - Range: 87.5 – 99.8%

Table 12. Coverage of screening

	Opt out	Opt in	Both	Total
*Number of sites**	40	3	1	44
*Number eligible**	181,807	15,203	3,535	200,545
*Number screened**	169,733	11,850	2,898	184,481
Mean coverage	93%	78%	82%	92%
Range	82%-100%	76%-83%		76%-100%

**Only counted sites that provided both number eligible and number screened (3 sites excluded as without Number Eligible, 2 sites excluded as without both)*

Table 13 shows the referral rate of the sites according to different professions conducting vision screening. 24 sites were excluded due to inaccurate data and 2 sites were removed due to missing data. Of the 23 sites that provided complete and accurate data, the overall referral rate is 13%. Group 1 (Orthoptists conducting vision screening) has the highest referral rate of 15%. The site mean referral rate and range is also listed in the table. The mean site referral rate and range for academic year 2016/17 & 2017/18 are also listed below.

- Mean overall site referral rate in 2016/17 was 14%; Range was 3% - 30%
- Mean overall site referral rate in 2017/18 was 12.9%; Range was 3% - 25%

Table 13. Referral rate per profession

Profession	1*	2*	3*	4*	Overall
Number of sites	8	7	8	0	23 #
Number screened	25,187	33,355	43,510	0	102,052
Number referred	3,867	4,384	5,043	0	13,294
Total % children	15%	13%	12%	0	13%
Site Mean	15.0%	12.5%	12.0%	NA	13%
Site Range	9%-23%	6%-23%	7%-19%	NA	6-72%

**1= Orthoptist; 2= VS trained by Orthoptist BIOS/ PHE package; 3= VS trained by Orthoptist local package; 4=VS not trained by Orthoptist*
 # 24 sites were excluded due to inaccurate data and 2 sites were removed due to missing data

Table 14a and b showed the distribution of the referral reasons of the children who failed the screening. The sites with accurate data are separated into two groups: **1. Sites that only test VA** (**Table 14 a) & 2. Sites that conducted orthoptic assessment and VA test (Table 14b)**. For the first group, only the two referral reasons are applicable as shown in Table 14a. The total %, site mean and range are therefore presented accordingly. For the second group, the distribution of all four referral reasons are shown in each column of Table 14b.

Table 14a. Referral reason (Sites that only test VA, n=22)

	1*	4*	Overall
Number of Children Failed	38,279	485	38,764
Total % of children	99%	1%	
Site Mean	92%	4%	
Site Range	84%-100%	0-16%	

**1 = failed vision test, 2 = failed vision test and orthoptic assessment, 3 = failed orthoptic assessment only (e.g. any or all of the following CT, OM, BV test), 4 = referred as unable to complete the test*

Table 14b. Referral reason (Sites testing VA and conducting orthoptic assessment, n=6)

	1*	2*	3*	4*	Overall
Number of children failed	1,424	798	275	99	2,596
Total % of children	55%	31%	11%	4%	
Site Mean	64%	22%	16%	5%	
Site Range	50%-95%	15%-28%	13%-21%	3%-7%	

**1 = failed vision test, 2 = failed vision test and orthoptic assessment, 3 = failed orthoptic assessment only (e.g. any or all of the following CT, OM, BV test), 4 = referred as unable to complete the test*

Table 15 shows the attendance rate of the children who failed vision screening. Sites without attendance data or with inaccurate attendance data (i.e. >100% attendance rate) were excluded. Z` Out of 19,859 children who failed and were referred, in total 13,549 children attended the appointment for further diagnostic eye examination. Attendance rate is shown according to the categories of appointment, namely orthoptic-led HES service, high-street optometrist and orthoptic-led HES service or high street optometrist base on set-criteria. Due to the large range the median is also shown. The highest mean attendance was recorded for orthoptic-led HES service (mean=78%, median 81%). The mean overall attendance and range for eye examination for academic year 2016/2017 and 2017/2018 are listed below.

- Mean attendance in 2017-2018 was 69%, range was 16.4% to 94.8%
- Mean attendance in 2016-2017 was 71%, range 27% to 95%

Table 15. Attendance for eye examination

	1*	2*	3*	Overall # (n=13,549)
Number of sites	27	1	11	39
Mean attendance	78%	32%	68%	76%
Median attendance	81%	32%	68%	75%
Range	39%-100%	NA	34%-97%	32%-100%

**1=All fails refer to orthoptic-led HES service, 2= All fails refer to high-street optometrist, 3= All fails refer to orthoptic-led HES service or high street optometrist based on set-criteria*
 # 8 sites were excluded for missing data

Table 16 shows the mean age and range, presented in months, of the children at 1st diagnostic test. Data from 35 sites were available. The mean age and range of the children at 1st diagnostic test for academic year 2016/2017 and 2017/2018 are also listed below for comparison.

- Mean age 2017/2018 56.1 months, range 52-67 months
- Mean age 2016/2017 was 61.0 months, range 42-70 months

Table 16: Mean age at 1st diagnostic test	
Number of sites	35
Mean age (months)	59.8
Range (months)	55.2-66.0

Table 17 shows the waiting time (in weeks) of children who failed screening to diagnostic appointment. 10 sites were excluded due to missing data. The mean waiting time (in weeks) and range of the children who failed vision screening to diagnostic appointment for academic year 2016/2017 and 2017/2018 are listed below.

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

Table 17: Waiting time from failed screening to diagnostic appointment in weeks	
Number of sites	39
Mean wait (weeks)	9.6
Range	4 to 40

Of 25,488 children who failed the screening, data regarding initial outcome was only available for 4,716 children (16 sites). Table 18a displays the initial outcome at the diagnostic eye examination for these 4,716 children all who were referred to HES (12 sites) or high street optician/HES depending on set criteria (4 sites). Different from academic 2017/2018, the initial outcomes of the eye examination of the present report were simplified into three outcomes. In total of the 4,716 children 3,720 required follow up visits after the diagnostic appointment. The mean % and range of each outcome are also listed in the table.

Table 18b shows the distribution of the referral pathway of the sites that provided inaccurate data regarding initial outcome of the eye examination. 33 sites were recorded with inaccurate data regarding initial outcome of the eye examination, for instance, number of children attended does not match with the sum of all outcomes, 20 of the sites referred children who failed vision screening to orthoptic-led HES, 1 of the sites referred children to high street optician and 12 to either high street optician or HES depending on set criteria.

Table 18a: Initial outcome of the diagnostic eye examination *

	VA 0.2 or better, no abnormality detected - Discharge	VA 0.2 or better, - Follow-up	VA worse than 0.2 - Treatment / Follow up
Number of children	996	434 $	3,286 $
Mean %	24%	9%	67%
Range	0%-44%	0-31%	53%-92%

**16 sites (n=4716) were included in the analysis of initial outcomes*
$ a total of 3,720 children were given a follow up visit

Table 18b: Referral pathway of sites with inaccurate data (n=33)

Orthoptic-led HES services	20
High street optometrist	1
Refer to high street optometrist or HES based on set criteria	12

iii. True-positive value of vision screening

The calculation of true-positive rate was also simplified in the current report compared to previous academic year's. Only the children with an initial outcome of VA worse than 0.2 who received treatment and/or follow up were categorised as positive from vision screening. The true positive rate was then calculated as:

*("VA worse than 0.2 requiring treatment/follow up"/ "Total number of children seen in diagnostic appointment") *100% = True-positive rate of vision screening"*

Table 19 shows the true-positive value of the vision screening programs, categorised by professionals conducting the screening. The number of sites, number of children seen and number of true positives of each category are listed in each row. The mean % and range of each category are also provided in the table. Vision screener trained by orthoptist with BIOS/PHE package has the highest true positive rate of 78%. The overall true positive rate of the sites is 71% with a range of 53%-94%.

Table 19:True-positive per professional

	1*	**2***	**3***	**4***	Overall
Number of Sites	5	6	4	0	15
Number of children seen	1,866	1,523	1,283	0	4,672
Number of true positives	1,267	1,147	872	0	3,286
Mean (%)	67%	78%	67%		71%
Range	56%-92%	57%-94%	53%-81%		53%-94%

**__1__= Orthoptist; __2__= VS trained by Orthoptist with BIOS package; __3__= VS trained by Orthoptist with local package; __4__=VS not trained by Orthoptist*

Table 20 presents the true positive value of the vision screening programs, categorised according to their compliance to PHE guidelines. Of the 15 sites that provided accurate data on true positive rate, 7 of them followed PHE guidelines. Sites that followed PHE guidelines showed a slightly higher mean true positive % of 75% with a range of 57%-94%.

Table 20: True positive per compliance to PHE guideline

	Yes	**No**
Number of sites	7	8
Number of children seen	2,507	2,165
Number of true positive	1,812	1,474
Mean %	75%	69%
Range	57%-94%	53%-85%

Table 21 presents the true-positive value of the vision screening programs, categorised based on whether a 2nd screening is provided for the children with borderline VA or non-cooperative in the 1st screening. The mean % and range of each group are listed in Table 21. Five sites provided 2nd screening for those with a borderline VA and recorded a 78% mean true positive rate compared to a mean true-positive rate of 72% where a 2nd screen was not offered for borderline fails on the first screening test.

Table 21: True-positive with/without second screening for borderline VA or non-cooperation

	2nd screening for borderline VA		**2nd screen -unable to test**	
	Yes	No	Yes	No
Number of sites	5	10	4	11
Number of children seen	1,265	3,407	974	3,698
Number of true positive	990	2,296	661	2,625
Mean %	78%	72%	70%	72%
Range	62%-92%	53%-94%	62%-91%	53%-94%

Discussion

Overview

In total 49 sites contributed to the vision screening audit report of the 2018-2019 academic year, a significant increase compared to the previous year (2017-2018, n=28) and comparable to 2016-2017 academic year (n=50). The data submission period for this year was extended due to poor response rate initially. This might be due to the first COVID-19 pandemic lockdown

restrictions, that started during the submission period. It is therefore encouraging to see an increase in number of sites participating in the vision screening audit in the current academic year with the extended data collection period. Nevertheless, due to this fact, one should also be aware that direct comparison of the key statistics between this year's audit and the previous year might not be appropriate. In the below sections, for the sake of illustrating the general trend of vision screening across the UK, key differences of the data compared with last year are still highlighted.

Vision screening program design

In total 204,856 children were screened by the 49 sites. Screening children at the age of 4-5 years and use of opt-out consent and has emerged as the de facto way of conducting vision screening in recent years. Comparable to previous years, 92% of the sites obtained consent via opt-out method. Forty-eight sites (98%) screened children at the age of 4-5 years, which is similar to year 2017-2018 (93%).

In terms of distribution of professions delivering vision screening amongst the sites, orthoptist doing vision screening constitutes the largest group (40%). Vision screener trained by orthoptist using the BIOS (now BIOS/PHE) training package, the largest group conducting vision screening in the previous year (2017-2018), is the second largest group (30%). Only 3 of these 49 sites (6%) dispatched vision screeners who were not trained by orthoptist to conduct vision screening. This suggests that orthoptist continues to play an important role in leading and/or delivering vision screening services.

The Keeler crowded logMAR vision test remains the most commonly used test in vision screening (53%) as recommended by PHE guidance. Other vision tests used by sites included HOTV logMAR chart, crowded Kays picture test with iSight Pro app on iPad, Sonksen crowded logMAR test, Thompson vision screener and Kays crowded logMAR test. Of the 49 sites that returned the questionnaire, in total 11 (22%) of the sites conducted orthoptic assessments in addition to vision test, all of which were carried out by orthoptists.

Twenty-nine of the sites (59%) used 0.200 logMAR each eye as the pass mark, which is a slightly lower percentage compared to submitted data last year (70%). The number of sites using 0.200 logMAR each eye and other orthoptist tests as passing mark was 10 (20%) compared with 4 (15%) in the previous year of data collection.

Ten (20%) of the sites provided second screening for children who weren't able to be tested and 4 (8%) sites provided second screening for those with a borderline failed VA. Both of these second screen protocols were provided in a lower percentage of sites than included in last year's audit (34% & 23% respectively). As shown in Table 21, sites that provided a second screening for borderline VA before referral had a slightly higher true-positive rate, but second screening of those unable to test did not show a higher true-positive rate. It should be noted that both borderline VA and unable to test second-screens had large ranges to the true-positive rates. The data suggests that unlike last year's audit result, providing second screening did not provide extra benefit in terms of true-positive rate. However, more data is required to make reliable conclusions and further cost-effectiveness analysis, not conducted in the current report, is warranted in the future.

The Public Health England guidance was published in October 2017 to facilitate standardisation of vision screening across England (PHE, 2017). Thus we compiled data regarding compliance to the PHE guideline of the sites, aiming to investigate the effect of the guideline on true-positive rate of the vision screening program. The criteria used to determine whether the screening program adheres to the PHE guideline is listed in appendix 2. Twenty (41%) of the sites adhered to the PHE guideline. It is encouraging to see that the true-positive rate is higher with those sites who adhered to the PHE guideline. However, a less than 50% adherence rate implies that more widely, a considerable amount of sites might not be following the PHE guideline whilst conducting their vision screening program. Further investigation, such as collection of data on whether sites are aware of the PHE guideline, and reasons for not following the guideline, is crucial in promoting standardisation of vision screening.

Vision screening outcome

Coverage

The mean coverage rate is 91.9% this year compared with 98.3% for academic year 2017-2018. Despite the apparent slight reduction in coverage, this year's audit included almost twice as many sites as academic year 2017-2018. Thus a mean coverage rate of 91.9% might reflect the true coverage of vision screening in England in a more pragmatic fashion, and is closer to the mean coverage of year 2016-2017, which had a similar number of sites included. The sites that used opt-out consent showed a much higher mean coverage rate (93.4%) compared with opt-in programs (78%). Yet, due to the size difference of the two groups, it is impossible to determine whether the difference is statistically significance. However, it is still concerning to see relatively low coverage in some of the sites with opt-out programs (i.e. 82%, Table 12). Further

investigation regarding barriers faced by the sites that resulted in a low coverage rate would be beneficial in providing guidance to increase coverage rate. These factors may be related to the information provided to parents or carers, language barriers, socio-demographic status, school attendance or other significant local considerations.

Referral rate and true-positives

The average referral rate across the data is 13%, which is similar to previous years. Orthoptist screeners have the highest referral rate (15%) compared to other professions conducting vision screening, most likely because in some sites they refer children with other target conditions (e.g. strabismus, ocular motility defects, absent stereopsis) compared to non-orthoptic screeners who screen just for reduced vision. We looked into the referral reasons of the professions accordingly. Ninety-nine percent of referrals of the sites that only tested VA, including some sites that deployed orthoptist conducting vision screening, were made because of reduced vision. The remaining referrals were made due to inability to complete the test. For those sites that included orthoptic assessment in the screening (which all were conducted by Orthoptists), 11% of the total referrals were due to failing orthoptic assessment, yet the exact reason for referral is not known due to the data collected in this audit. This shows that even when orthoptists were the vision screeners using additional orthoptic assessment, almost all children were referred because of reduced vision. Also when orthoptists deliver VA test only screening there is no indication that they adapt referral criteria if they observe other signs. It would be justified to investigate further the cost-effectiveness of these varied personnel.

Table 19 demonstrated that mean true-positives were highest in sites delivering screening by vision screeners trained using the PHE/BIOS package, it can be seen however that the range of true-positives were similar for this personnel group (57-94%) and Orthoptists delivering (56%-92%). Screening delivered by non PHE/BIOS trained personnel however had lower mean (67%) and range (53-81%). This is concerning as these screeners were testing for reduced VA only and have considerably lower outcomes than those with BIOS/PHE training. For Orthoptists as screeners the slightly lower mean true-positive rate, relates to the target condition used for this report being reduced vision (worse than 0.2), whereas Orthoptists may have referred for other conditions such as strabismus and ocular motility defects with VA being unaffected.

The true-positive rate for the sites that complied with PHE guideline are higher than those that did not (see Table 20). The difference is also observed in the range of the two groups (57%-94% vs 53%-85% respectively). This provides supporting evidence that programs using PHE guidelines have improved effectiveness of vision screening for reduced vision.

Conclusion

This report provided a snapshot of the current practices of vision screening across the UK. We employed a simpler definition of true positive rate this year. Under the revised definition vision screeners, trained by orthoptists using the BIOS/PHE package, conducting vision screening recorded the highest true positive rate. Sites that followed PHE guidelines had a higher true positive rate in general compared with those who didn't. However, significant portion of inaccurate or missing data limited the room for analysis beyond descriptive statistics and limited the conclusions that can be drawn regarding personnel and program design. Future reports should focus on areas such as the reason for low coverage rate in sites, list of orthoptic conditions that were referred during vision screening and reasons for not following PHE guidance. Other ways to enhance the efficiency of the data collection process and the robustness of the data are also crucial for future reports.

References:

Hall D.M.B., Elliman D. (2003) Screening for vision defects. In: Health for all children. 4th Edition. Hall DMB, Elliman D. Oxford: *Oxford University Press*. pp 230–244

Public Health England (PHE). (2017). Guidance: Child Vision Screening. https://www.gov.uk/government/publications/child-vision-screening (accessed 09/02/21)

Powell C, Hatt SR. Vision screening for amblyopia in childhood. Cochrane Database of Systematic Reviews. 2009(3).

Solebo, A., Cumberland, P., & Rahi, J. (2015). Whole-population vision screening in children aged 4-5 years to detect amblyopia. *The Lancet, 385*(9984), 2308-2319.

Tailor, V., Bossi, M., Greenwood, J., & Dahlmann-Noor, A. (2016). Childhood amblyopia: Current management and new trends. *British Medical Bulletin, 119*(1), 75-86.

UK National Screening Committee. (2019). The UK NSC recommendation on Vision defects screening in Children. http://legacyscreening.phe.org.uk/vision-child (accessed 09/02/21)

Vision in Preschoolers Study Group. Comparison of preschool vision screening tests as administered by licensed eye care professionals in the Vision in Preschoolers Study. Ophthalmology. 2004 Apr 1;111(4):637-50.

Appendix 1: BIOS School Vision Screening Audit Spreadsheet Codes 2018-19

BIOS School Vision Screening Audit Spreadsheet Codes 2018-19 BIOS VS CAG 07/02/20

Important Notes

There are **three** worksheets in the Excel return workbook, and the titles of these are given at the bottom of the document – just click on the title to open the sheet. They are:

- **Site Information** – this has columns A to M, and will provide the basic information about the screening provided in your area.
- **Screening data 2018-2019** – this has columns A to Z, and is for the screening data for the academic year 2018- 2019 in your area. e.g. September 2018 to July 2019 in England and Wales
- **Area codes** – This contains new codes for the 2018-19 academic year

When completing the Excel data return for the vision screening in your area, please refer to the information / guidance given on this code sheet below. Please note that:

- Some of the columns require the actual number of children.
- Other columns require you to enter a code number. Where a code is required in a column, a descriptor is given for each code number in the comment box on the spreadsheet and in the details provided on this code sheet; please use the code number that describes your area, data or information that is being requested. If your response is 'other' please add comments to explain what your answer as directed on the spreadsheet.

To help you, each column has a small red triangle in the top right hand corner. Clicking on this triangle will give you details of the information required in the column and will direct you to this code sheet for more information if necessary.

Worksheet 1: Site Information (See 1st tab at the bottom of the workbook)

Column	Data type	Description
A	Area Code	Use your new area code from the 2018-19 area code list shown in worksheet 3
B	Area name	Use your area's ID name from BIOS maps
C	Contact email	email address of person submitting the data, (to enable contact if any queries with the data)
D	Consent	Your area's consent policy: 1 = opt-out 2 = opt-in

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Column	Data type	Description
E	Age	Age at which children are screened in your area 1 = age 4 – 5 years 2 = other If answering other [2], add age screening completed in cell E4
F	Professional	Professional who undertakes the screening: 1 = orthoptist 2 = vision screener trained by orthoptist with PHE/BIOS training package 3 = vision screener trained by orthoptist with local training package 4 = vision screener not trained by orthoptist
G	Test/s	Test/s 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 If answering 'other VA test' [3 or 4], please state what test is used in cell G4
H	Pass criteria	Pass criteria used: 1 = 0.200 each eye 2 = 0.200 each eye and other orthoptic test(s) 3 = other * * If answering 'other' [3], please state what referral criteria is used in cell H4
I	2nd screen – unable to test	Procedure if the child has poor co-operation / is unable to complete the test 1 = a second screening test is performed on another day 2 = the child is referred to the diagnostic pathway 3 = other* *If other [3] please provide details in cell I4

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J	2nd screen – borderline VA	Do you perform a second screening if the child has borderline fail VA? 1 = yes a second screen is performed if the VA is borderline * 2 = no all children referred immediately if they fail * If yes [1] please indicate the criteria for borderline in cell J4
K	Referral pathway	Your area's care pathway for children who fail the screening: 1 = all fails referred to Orthoptic led HES service (including community clinics run by HES) 2 = all fails referred to high street Optometrist 3 = referral to HES and own Optometrist based on set criteria
L	Eye exam	Indicate the type of eye exam the child receives having failed the screening in your area's care pathway: 1 = Assessment of vision (R+L) Keeler Crowded LogMAR, Assessment of Binocular vision, motility and cycloplegic refraction & fundus / media exam for every child referred 2 = testing determined by eye care professional 3 = other * *If answering 'other' [3], please state what referral criteria is used in cell L4
M	Management criteria	Indicate the criteria used to determine the treatment / management of the child: 1 = evidence-based criteria used to determine if treatment required i.e. level of vision and refractive guidelines used. 2 = based on opinion / clinical judgement of individual professional 3 = other or a combination of 1 and 2 * * If you answer other or combination [3], please explain the answer in cell M4

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Worksheet 2: Screening Data for Sept 2018 - August 2019 (See 2nd tab at the bottom of the workbook)

Column	Data type	Description
A	Number eligible	number of children in your area in the target age group for vision screening
B	Number screened	number of eligible children actually screened
C	Number declined	number of eligible children for whom parents declined the screening offer
D	Passed	number of children who passed the screening
E	Failed	number of children who failed the screening and referred
F - I	Referral reason	Reason for the referral / fail – please indicate the **number of children** in each category 1 = failed vision test 2 = failed vision test and orthoptic assessment 3 = failed orthoptic assessment only (e.g. any or all of the following CT, OM, BV test) 4 = referred as unable to complete the test
J	Number seen	number of children referred who attended for diagnostic eye examination
K	Mean age	mean age in months of children seen at the 1st diagnostic eye examination
L	Age range	give the age range in months of these children at time of first diagnostic eye examination
M	Mean wait	mean waiting time in weeks from screening test to offered diagnostic eye appointment

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Column	Data type		Description
N to P	Initial Outcomes		Number of children in each category for the ***initial*** outcome of the diagnostic eye exam ***(i.e the outcome of the first diagnostic eye examination having failed the school screening):***
		Column N	VA 0.2 or better, no abnormality detected - Discharge (False positive)
		Column O	VA 0.2 or better, - Follow-up (False positive for reduced VA)
		Column P	VA worse than 0.2 - Treatment / Follow up (True positive)
Q to Y	Diagnosis		Number of children in each of the following diagnostic categories based on the ***initial*** *outcome* ***(i.e this is the diagnosis based on the outcome of the first eye exam having failed the school screening) Please note that this should include children identified in columns O or P only):***
		Column Q	1 = refractive error only - requiring glasses
		Column R	2 = manifest strabismus only (constant, intermittent or microtropia)
		Column S	3 = manifest strabismus and refractive error (requiring glasses)
		Column T	4 = ocular motility defect only
		Column U	5 = poor convergence only
		Column V	6 = no confirmed abnormality (VA 0.2 or better) but review as poor cooperation, or borderline results
		Column W	7 = ophthalmic pathology only, i.e. VA 0.2 or better (eg. ptosis)
		Column X	8 = ophthalmic pathology with reduced vision i.e VA worse than 0.2
		Column Y	9 = other *
			*If answering 'other' [9], please state diagnostic category cell Y4

Z Map: Please indicate if you would like your area to be identified on the audit map to show that you submitted data and contributed to the report. Please note that your area data will not be identifiable in relation to the whole data analysis within the report.

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Appendix 2: *Criteria used to decide whether a site followed PHE guideline*

1. Screening offered to all children aged 4-5 years
2. Screening conducted by vision screener trained by orthoptists using PHE guideline or orthoptists
3. The Keeler crowded logMAR test is used to test children's visual acuity
4. The passing criteria is 0.200 logMAR or better

Appendix 3: *List of sites contributing to the 2018-2019 audit*

1. West Sussex
2. South Cumbria
3. Cornwall and Isle of Scilly
4. Barnet
5. Barnsley
6. Shropshire
7. Telford and Wrekin
8. York
9. Knowsley
10. Birmingham
11. Bedford
12. Central Bedfordshire
13. Luton
14. Aneurin Bevan
15. Bromley
16. Southampton & Hampshire
17. Sunderland
18. Milton Keynes
19. Worcestershire
20. Lambeth and Southwark
21. Abertawe Bro Morgannwg
22. Exeter, East & Mid Devon
23. Birmingham and Sandwell
24. South Cheshire and Vale Royal
25. East Sussex
26. Staffordshire
27. Stoke on Trent
28. Gloucestershire
29. Hertfordshire
30. Bradford
31. North Yorkshire
32. Bracknell Forest
33. Slough
34. Windsor and Maidenhead
35. Stockport
36. Leeds
37. Swindon
38. Suffolk
39. Norfolk
40. Tameside
41. Plymouth
42. Northumberland
43. Gateshead
44. Newcastle
45. Salford
46. Wandsworth
47. Oxford
48. Trafford
49. Norwich

Appendix 4: BIOS Recommended Vision Screening Monitoring

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 2016-2017	Academic Year 2017-2018	Academic Year 2018-2019
KPI 1	93%	98%	92%
KPI 2	13%	13%	13%
KPI 3	71%	76%	73%
KPI 4	81% (Method 1) 61% (Method 2) 67% (Method 3)	76% (Method 1) 65% (Method 2) 70% (Method 3)	71% (Overall mean)

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

	Academic Year 2016-2017	Academic Year 2017-2018	Academic Year 2018-2019
AD 1	175,407	116,854	200,545
AD 2	162,868 (93%)	114,831	184,481 (91.95%)
AD 3	60 months	55 months	59.8 months
AD 4	7.7 weeks	8.6 weeks	9.6 weeks