BIOS BRITISH AND IRISH ORTHOPTIC SOCIETY

BIOS VISION SCREENING AUDIT

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Dr. Miriam Conway

Division of Optometry & Visual Science

School of Health & Phycological Sciences

City, University of London

Mr Asad Atiq

The Royal Wolverhampton NHS Trust

Lee Pentland

Ninewells Hospital Tayside

Ms Courtney Powdrill

Moorfield Eye Hospital NHS foundation

For BIOS Vision Screening Clinical Advisory Group

Abbreviations

BIOS-British Irish orthoptic Society

CAG- Clinical Advisory Group

HES- Hospital Eye Service

Optom- Optometrist

NHS- National Health Service

NSC-National screening Committee

PHE- Public Health England

VS- Vision Screeners

Introduction

Screening is a fundamental tool in public health, aimed at identifying individuals who may have an increased risk of developing specific conditions, even if they appear to be healthy (gov.uk, 2023). The provision of screening is contingent upon the availability of successful interventions. The UK National Screening Committee recommends that all children aged 4 to 5 years old undertake a vision test on both eyes in order to identify reduced vision, which should then be referred for further investigation (gov.uk, 2023). The primary aim for this programme is to detect reduced vision caused by amblyopia although other conditions such as refractive error, manifest strabismus and pathology might also be identified when they are referred for further diagnostic assessment (gov.uk, 2023). Early detection of amblyopia is crucial as it reduces the severity of permanent visual impairment by facilitating timely treatment during the sensitive period (Solebo et al., 2013).

Untreated amblyopia almost doubles the risk of bilateral visual impairment (Van Leeuwen et al., 2007). It is also known to impact activities such as reading (Kanonidou et al., 2010, 2014; Kelly et al., 2015), reaching and grasping (Grant et al., 2014; Grant & Conway, 2015), navigating obstacles (Buckley et al., 2010), and motor skills (Webber et al., 2008). Reduced stereopsis associated with amblyopia has been linked to more cautious driving behaviour in driving simulations. (Bauer et al., 2001; Tijtgat et al., 2008). Taxi drivers with binocular vision anomalies report a higher rate of accidents (Maag et al., 1997). In the general population, individuals between the ages of 17 and 33 with moderate or severe amblyopia report higher numbers of road traffic accidents (Rahi et al., 2006). Young adults with either unilateral visual impairment or amblyopia were less likely to acquire a driving license (Baker et al., 2019). Children with strabismic or mixed amblyopia are at greater risk of poor school readiness at 3 years old (Gitsels et al., 2020). Nevertheless, it is not significantly associated with adverse cognitive performance and trajectories in early schooling. Adult patients with amblyopia report that the condition interfered with their quality of life, including education, and their work (Packwood et al., 1999), as well as day to day activities (Kumaran et al., 2019). Decreased presenting visual acuity (best visual acuity right or left eye, with glasses if worn) at school entry is associated with reduced literacy (Bruce et al., 2016).

The British and Irish Orthoptic Society (BIOS) Vision Screening Clinical Advisory Group (CAG) aims to enhance the quality of vision screening to ensure best practices are followed. In England it is important to promote the Public Health England (PHE) guidelines (Public Health England, 2017) and determine both the compliance and the potential impact that adherence to these guidelines brings. In NHS Scotland all pre-school children are offered a pre-school eye test. This is an Orthoptic delivered national screening programme. It is therefore important to compare both countries against their own requirements. The primary purpose of any clinical audit is to facilitate quality improvement where it is most beneficial and improve outcomes for patients. It will also enable orthoptists and commissioners to make informed choices with regards the commissioning of their screening service. Additionally, the present audit aimed to gain insights of the COVID-19 pandemic on vision screening practices.

Information about the pandemic

On the 26th of March 2020, lockdown measures legally came into force within the United Kingdom (Institute for government, 2022). People were only allowed out of their house for medical treatment, essential shopping, work and one form of exercise per day. On the 20th of March 2020, with the exception of vulnerable children and those with key worker parents,

schools suspended in person activities for the majority of pupils (BBC, 2020). Some primary schools reopened for pupils in reception, year 1 and Year 6 on the first of June 2020 (BBC, 2020). Later in June up to a quarter of Year 10 and Year 12 were allowed some contact to prepare for exams (BBC, 2020). On the 14th of August lockdown restrictions were eased further including the reopening of theatres and bowling alleys. September the 14th 2020 the rule of six applied to indoor and outdoor gatherings applied in England. October the 31st England enters a second lockdown in order to prevent a "medical and moral disaster". December the 2nd 2020 second lockdown ends. January the 6th 2021 England enters a third lockdown, March 8th 2021 schools in England reopen. 19th of July most legal limits on social contact removed in England.

Method

In November 2021 an e-mail was sent to all orthoptic departments requesting the return of their vision screening audit data, relating to the academic year 2020-2021. Every screening lead, in the UK and the Republic of Ireland, was required to complete two excel worksheets and then send their workbook to a specified e-mail address. They were also sent an audit guidance document outlining the correct procedure for audit completion. The first excel worksheet included site data such as the area code, the contact person and also details about their vision screening methodology. The second excel worksheet comprised screening data containing the numbers of children eligible, the numbers of children that passed and failed, the numbers that declined and also the reasons for their referral. The third worksheet sheet included the name of every potential vision screening site, plus a unique area code related to that site. A comprehensive list of all the information requested is provided in Appendix 1. The list was shortened this year, to reduce the administrative burden on the NHS post COVID 19 pandemic. The original deadline was end of August 2022, however due to a poor response rate initially, this was extended until November 2022.

The accuracy of the of each dataset was based on the 3 criteria documented below. The authors of the report contacted the corresponding site and amended any inconsistent data wherever possible. If the data remained partially inaccurate, it was only included in the analysis for the sections or sections deemed to be correct.

1. The number of children who passed and failed the screening must equal the number of children screened

2. The numbers of referral reasons must total the number of children who failed their screening

3. The number of children referred to the HES and their own optometrists must add up to the numbers of children that failed.

Results

203 sites across the UK and the Republic of Ireland were identified in total. 169 English sites, 14 Scottish sites, 8 Welsh sites, 5 Northern Irish sites, 4 Republic of Ireland sites, 2 Channel Island sites and 1 site for the Isle of Man. An additional e-mail was sent out to all orthoptic departments via BIOS to ask “If departments are unable to provide the data, could you, please request that they contact us with a reason.” From this e-mail we received an additional 13 Reponses (Table 1). Three percent were unable to provide us with any data due to COVID, 2.5% of departments no longer carried out any vision screening, 0.9% stated that although they provided training to vision screeners they were not sent any data and therefore could not contribute to the audit.

Table 1: Reasons - no audit data sent

	Number of Sites Total =203	Percentage of Sites
COVID	6	3%
Vision screening stopped	5	2.5%
Train screeners no data	2	0.9%

Thirty-eight (18.7%) orthoptic departments returned either partial or complete data sets. The highest return rate was from Scotland at 64.3% followed by England with 16.6% and then Wales with 12.5%. Northern Ireland, Republic of Ireland, the Channel Islands and the Isle of Mann did not return any data sets (Table 2).

Table 2: Coverage of sites across UK & Republic of Ireland

	Number of Sites Total =203	Percentage of Sites
All	38	18.7%
England	28	16.6%
Wales	1	12.5%
Scotland	9	64.3%
Ireland	0	0%
Norther Ireland	0	0%
Channel Islands	0	0%
Isle of Mann	0	0%

Out of the 35 sites with accurate data in this section 146,504 children were eligible to be screened. In total 126,915 children received vision screening suggesting there was a mean

site coverage of 86.2% and a variability ranging from 46.9%-100%. The average site coverage and range for academic year 2018-2019 & 2019-2020 are documented below.

- 2020-2021 Average site coverage 86% (Range 46.9%-100%)
- 2019-2020 Average site coverage 82.5% (Range 21.2%-100%)
- 2018-2019 Average site coverage 91.9% (Range 76%-100%)

Across the entire cohort 35 out of 38 sites (92.1%) used an opt-out screening consent, the remaining 7.9% used an opt-in strategy (Table 3). 100% used an opt-out strategy in both Scotland and Wales, 89.3% used it in England. The opt-out strategy produced a similar mean coverage rate at 86% when compared to the opt-in method which produced 89% coverage rate (Table 4). In 2019-2020 the coverage for the opt-out and the opt-in strategies were recorded as 83.2% and 56.2%, respectively. These figures suggest that for both consent strategies the coverage was increased this year. The biggest improvement was for the opt-in strategy There was a small difference between the mean coverage rates between England (88.1%), Scotland (80.7%) and Wales (95%). Little conclusion can be drawn from Wales as only 1 site was included (Table 5).

Table 3: Distribution of methods used for obtaining consent for screening

	Number of Sites	**Percentage**
Opt-Out	35	92.1%
Opt-In	3	7.9%

Table 4: Coverage of Screening by Consent

	Opt-Out	**Opt-In**
Number of sites	33	2
Number eligible	136444	10060
Number screened	117927	8988
Mean coverage across sites	86%	89%
Range	46.9%-100%	87.9%-90%

Table 5: Coverage of Screening by Country

	England	**Scotland**	**Wales**
Number of sites	25	9	1
Number eligible	91854	47729	6921
Number screened	82567	37774	6574
Mean coverage across sites	88.1%	80.7%	95%
Range	46.9%-100%	59.3%-99.9%	1 site

33 sites included information about the numbers of parents or guardians who declined vision screening (Table 6). On average 4.7% of parents or guardians declined with a range lying between 0% and 39.9%. There was a slightly larger percentage of parents or guardians who declined in Scotland compared to England.

Table 6: Percentage declined by country

	England	**Scotland**	**Wales**	**Overall**
Number of sites	24	9	1	33
Mean declined across sites	3.1%	8.5%	Unknown	4.7%
Range	0%-10%	0.1%-39.9%	Unknown	0%-39.9%

As NHS England and Scotland have different vision screening guidelines, we have separated their information by country to reflect these differences (Table 7). Results reveals that within Scotland 100% of sites carried out vision screening at 3.5 -5.5-year-old. In Wales 100% carried out vision screening at 4-5-years. In England 96.4% carried out vision screening at 4-5-years-old. The remaining one site in England completed vision screening for that year when the children were slightly older due to delays in testing caused by the pandemic.

Table 7: Distribution of the age at which screening was delivered

	All sites Number of Sites (%)	**England Number of Sites (%)**	**Wales Number of Sites (%)**	**Scotland Number of Sites (%)**
3.5-5.5 years old	9 (23.7%)	0 (0%)	0 (0%)	9 (100%)
4-5 years old	28 (73.7%)	27 (96.4%)	1 (100%)	0 (0%)
4-6 years old	1 (2.6%)	1 (3.6%)	0 (0%)	0 (0%)

Across all sites the distribution of professionals carrying out vision screening was highest for both the orthoptists (47.3%) and the vision screeners trained with the BIOS package. Only one site reported vision screeners trained with either a local package or not trained by an orthoptist (Table 8). 100% of Scottish sites used orthoptists to carry out vision screening as it is an orthoptic delivered screening service. In England vision screeners trained with the BIOS package was the most prevalent followed by orthoptists themselves.

Table 8: Distribution of professionals who delivered the screening

	All sites Number of Sites (%)	England Number of Sites (%)	Wales Number of Sites (%)	Scotland Number of Sites (%)
Orthoptists	18 (47.4%)	9 (32.1%)	0 (0%)	9 (100%)
VS BIOS	18 (47.4%)	17 (60.7%)	1 (100%)	0 (0%)
VS local	1 (2.6%)	1 (3.6%)	0 (0%)	0 (0%)
VS not trained	1 (2.6%)	1 (3.6%)	0 (0%)	0 (0%)

In England over 80% of sites used Keeler vision tests in isolation with a further 14.3% using Keeler vision plus a range of orthoptic tests (Table 9). 100% of Scottish orthoptic departments used other vision tests (Keeler, Sonksen and Kay Pictures Crowded), plus a basic orthoptic assessment. In Wales the only site used Keeler vision in isolation.

Table 9: Distribution of the test/s used to carry out vision screening

	All sites Number of Sites (%)	England Number of Sites (%)	Wales Number of Sites (%)	Scotland Number of Sites (%)
Keeler only	25 (65.8%)	24 (85.7%)	1 (100%)	0 (0%)
Keeler & Orthoptic	4 (10.5%)	4 (14.3%)	0 (0%)	0 (0%)
Other Vision only	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Other Vision & Orthoptic	9 (23.7%)	0 (0%)	0 (0%)	9 (100%)

In England the pass criteria used by the majority of sites was vision/visual acuity better than 0.20 (Keeler LogMAR) in both eyes. This year's figures 82.1% is an increase on last year's 2019-2020 figure of (71.4%). Other sites in England used either a combination of vision better than 0.20 in both eyes in addition to passing a range of orthoptic tests or other, which was passing using a different vision threshold in both eyes (Table 10). In Scotland 100% used the other criterion, which was vision poorer than 0.200 Keeler LogMAR, 0.100 Sonksen LogMAR/KayPciture Crowded, in addition to passing basic orthoptic tests.

Table 10: Pass criteria adopted by sites

	All sites Number of Sites (%)	England Number of Sites (%)	Wales Number of Sites (%)	Scotland Number of Sites (%)
0.20	24 (63.2%)	23 (82.1%)	1 (100%)	0 (0%)
0.20 & Orthoptic	2 (5.3%)	2 (7.1%)	0 (0%)	0 (0%)
Others	12 (31.6%)	3 (10.7%)	0 (0%)	9 (100%)

In 2019-2020 figures in England showed a slight bias for not offering a second vision screening opportunity (60.7%) if the screener was initially unable to test the child. This year figures were similar in England 64.3%. In Scotland more sites (44.4%) this year also, said no to offering a second test if the child was initially unable to test. In Scotland the two sites that recorded other in their audit data, referred all the children with additional special educational needs, if they were unable to test during the first visit. The others were allowed a second vision screening opportunity.

Table 11: Distribution of second screening offered if unable to test

	All sites Number of Sites (%)	England Number of Sites (%)	Wales Number of Sites (%)	Scotland Number of Sites (%)
Yes	13 (34.2%)	10 (35.7%)	0 (0%)	3 (33.3%)
No	23 (60.5%)	18 (64.3%)	1 (100%)	4 (44.4%)
Other	2 (5.3%)	0 (0%)	0 (0%)	2 (22.2%)

In England figures increased to 67.9% not offering a second vision screening if the children produced a borderline pass (Table 12). In 2019-2020 the number was 53.6%. Scotland also showed a slight preference towards not offering a second screening 66.7% however these figures were the same as the previous year.

Table 12: Distribution of second screening offered if borderline

	All sites Number of Sites (%)	England Number of Sites (%)	Wales Number of Sites (%)	Scotland Number of Sites (%)
Yes	12 (31.6%)	9 (32.1%)	0 (0%)	3 (33.3%)
No	26 (68.4%)	19 (67.9%)	1 (100%)	6 (66.7%)

In England most sites (67.9%) referred all their patients to the hospital eye service. In Scotland most sites (66.7%) referred their patients to either the hospital eye service (Ophthalmologist or Optometrist) or to the community optometrists. No sites referred all their patients to the optometrist (Table 13).

Table 13: Distribution of the referral pathway

	All sites Number of Sites (%)	England Number of Sites (%)	Wales Number of Sites (%)	Scotland Number of Sites (%)
HES	22 (57.9%)	19 (67.9%)	0 (0%)	3 (33.3%)
HES & Optom	16 (42.1%)	9 (32.1%)	1 (100%)	6 (66.7%)
Optom	0 (0%)	0 (0%)	0 (0%)	0 (0%)

The average failure rate for all professionals was 14.8%. This figure was then broken down further into failure rate by profession. Orthoptists and vision screeners trained by the BIOS package had a similar failure/referral rate with the orthoptists referring slightly more (Table 14). No screeners were trained by an orthoptist using a local package. The one vision screener who was not trained by an orthoptist reported a larger failure/referral rate.

Table 14: Failure rate by profession

	All sites	Orthoptist	VS BIOS	VS local	VS not
Number of sites	35	16 (45.7%)	18 (51.4%)	0 (0%)	1 (2.9%)
Number Screened	126915	65317	60123	0 (0%)	1475
Number failed	19203	10966	7946	0	291
Mean % failed	14.8%	16%	13.3%	0	19.7%
Range	7.3%-23.2%	8.6%-23.2%	7.3%-20.3%	N/A	N/A

The failure rate in Scotland (18.8%) and Wales, (16.9%) was higher when compared with England overall 13% (Table 15).

Table 15: Failure rate in all countries

	England	Wales	Scotland
Number of sites	25	1	9
Number Screened	82567	6574	37774
Number failed	10592	1112	7499
Mean % failed	13%	16.9	18.8%
Range	7.3%-20.3%	N/A	12.9%-23.2%

Those who offered a second screening to children with borderline visions failed slightly more than those who did not offer a second vision screening (Table 16).

Table 16: Percentage borderline fail offered second screen

	Yes-Second Screen	No Second Screen
Percentage Fail	15.9%	14.4%

In all countries the main reason for failing vision screening was not passing the vision tests in one or both eyes (Table 17), range between 69.1%-90.1%. In Scotland significant numbers were also failed for an orthoptic anomaly.

Table 17: Referral reason:

	Failed vision	Failed vision & orthoptic	Failed orthoptic only	Unable to test	Under HES
Average referral reason England	90.1%	1.1%	0.8%	5.8%	2.2%
Average referral reason Scotland	69.1%	16.4%	9%	5.6%	0%
Referral reason Wales	88.6%	0%	0%	11.4%	0%

In England 82.1% of sites were compliant with the criteria (Appendix 2) used to decide whether a site followed PHE guidelines (Table 18). This is an improvement on the 67.9% data for 2019-2020. In Scotland 100% were again compliant with NHS Scottish guidelines (Appendix 3)

Table 18: Percentage of sites in England using PHE guideline

	Not compliant PHE	Using PHE	Changed due to COVID
Number of sites	5	23	1
Percentage	17.9%	82.1%	N/A

Discussion

Overview

In the academic year 2020-2021, 38 sites contributed to the audit report. Numbers are the same as the previous academic year. They are still lower than the pre-pandemic levels however, during 2018-2019, where a total of 49 sites contributed to the audit report. The data submission period was extended initially by a period of many months, due to the COVID-19 pandemic. It should also be highlighted that it is difficult to compare any of this year's data to any previous statistic's, due to the potential impact of the pandemic. Nevertheless, we felt it was appropriate to collate the audit data. An additional 13 orthoptic heads of department emailed to explain the reason why they were unable to complete their audit return. The most common reason quoted was the pandemic, followed by the fact that vision screening had been cancelled or that the fact that they only trained the vision screeners and had no access to the data themselves. The highest return rate was from Scotland at 64.3%, followed by England with 16.6% and then Wales with 12.5%. Unfortunately, no other data was returned from any other country or island.

Vision screening program design

Public Health England (PHE) reports that the commissioner should determine whether to provide an opt-in or an opt-out service. They also acknowledge that whilst an opt-out service produces higher uptake levels it might run the risk of a child being screened when their parents might have wished otherwise. Data Suggest this problem is extremely rare as only 5 complaints were received in relation to this topic from all 12 Scottish Health Boards for the past 7-8years. Four were dealt via a phone call and the other identified that the problem was related to how the nursery was gaining consent. During this academic period the predominant method of gaining consent, to carry out vision screening, was to use an opt-out policy. This method was used by 92.1% of sites and is very close to the 2019-2020 submission. Overall the 86% mean coverage for the opt-out was higher than the previous academic year. This trend is unsurprising in light of the fact that it was the second academic year of the pandemic and it is likely departments had adapted to lock downs. Inconsistent with previous years data, the level of coverage for the opt-out strategy was 3% lower when compared against the opt-in approach. Only 2 schools returned data using the opt-in consent tactic, both schools showed a high coverage. One of the schools explained that they needed to "Work really hard to engage our schools to complete the consent forms." Sometimes the parents/guardians required repetitive attempts by the team in order to gain either written or verbal consent. They used a team of people involving the teachers, secretaries and the vision screeners in order to ensure high completion. Coverage figures across the different countries appear to vary significantly with Wales and England achieving a slightly higher coverage than Scotland. Overall the numbers of parents or guardians that declined the vision screening was small (4.7%). These figures were slightly increased to the previous academic year.

In total 126,915 children received vision screening across 35 sites. The UK National Screening Committee and PHE recommends that screening of children's vision should be offered to all children aged 4 to 5 years. In Wales and England 100% of sites carried out vision screening at 4-5 years old, until the pandemic occurred when it was necessary for one site to complete vision screening for children when they were slightly older. This was because the vision screeners were unable to initially collect the data at the appropriate age

due to school closures. In Scotland because of the way the school system is set up 100% of sites carried out vision screening when the children were aged between 3.5-5.5 years old.

Across all countries, either orthoptists or vision screeners trained using the PHE/BIOS recommended package, were the largest group of professionals delivering vision screening. Only one site used vision screeners trained with either a local package or vision screeners not trained by an orthoptist. This finding is unsurprising as the pandemic has likely put an increased strain on orthoptists time due to the large backlog of patients. In Scotland orthoptists delivered 100% of the vision screening. This can be contrasted with England where vision screeners trained by the BIOS package delivered the majority of vision screening. The explanation for this difference can be explained by the fact that Scotland carries out basic orthoptic tests including orthoptic tests therefore making it essential to have orthoptists delivering at least part of this model for vision screening.

The Scottish pre-school orthoptic vision screening program, tests for visual defects in children during their pre-school year (NHS Scotland, 2019). Visual-Acuity can be tested with either the Keeler logMAR, the Sonksen logMAR or Kays Pictures crowded (KPC). In Scotland all orthoptists used a crowded LogMAR test as their first choice. However, if a child is unbale to co-operate with this, KPC will be used. The orthoptist will also carry out a basic orthoptic assessment which includes; Cover Test (33cm and 6m), convergence, ocular motility, prism reflex test and a screening stereo test. In England all vision screeners are recommended to follow PHE guidelines which states that all children who participate are tested by an orthoptist-led screening service, using the Keeler crowded logMAR test (Public Health England, 2017). Over four fifths of sites were compliant with this guideline and used the Keeler vision test in isolation to carry out vision screening. Under a fifth used the Keeler logMAR and a number of orthoptic tests. More sites in England were complaint with this guideline this year. The only site to submit in Wales was compliant with PHE's guidelines (Public Health England, 2017) and used a Keeler vision test in isolation.

Public Health England (Public Health England, 2017) also recommends that every child with a visual acuity worse than 0.20 logMAR on the Keeler crowded logMAR test in one or both eyes is referred for further examination. In England although the majority of sites used a vision of 0.20 or better in both eyes, significant numbers also used criterion beyond what was recommended by PHE (Public Health England, 2017) which was 0.20 plus passing a range of orthoptic tests or a vision level different than 0.20 in both eyes. In Wales the only submission also used 0.20 or better as a pass criterion for both eyes.

In Scotland, NHS Scotland recommends that every child with either a visual acuity worse than 0.20 in either eye with the Keeler LogMAR or an interocular difference of more than 3 letters be referred. Alternatively, they may also be referred if they have a visual acuity worse than 0.10 in either eye using the Sonksen logMAR or Kays pictures crowded test or an interocular difference of more than 3 letters. The final referral criterion was any significant manifest deviation, esophoria, decompensating heterophoria, ocular motility defect, reduced convergence or poor motor fusion (NHS Scotland, 2019). In Scotland all (100%) of the vision screeners used a pass criterion of worse than 0.20 or 0.10 in either eye depending on the vision test, and or a failure of one or more of the other orthoptic criteria. For full information see Pentland and Patel 2020).

Public Health England states that all children unable to complete the screening test due to lack of co-operation either undergo a second testing attempt or are referred directly onto community or hospital eye service (Public Health England, 2017). The number of sites offering a second vision screening opportunity to children unable to test on the first occasion was again divided across all the sites with some offering this opportunity and other sites

directly referring. The numbers providing this opportunity was less than previous academic years and again possible reflects the pressures of the large waiting list created by the lockdowns during the pandemic. A small number of sites based their decision on whether the child had additional support needs or not. Those with additional needs were referred directly to the hospital those without were offered a second vision screening opportunity. The same pattern was shown for those children who were borderline on the first visit with more sites not providing this opportunity in comparison with the previous year.

In England the majority of sites referred all their failures entirely to the hospital eye service, the second commonest pattern was to refer some of their patients to the hospital eye service and the other portion to the optometrist. In Scotland this situation was reversed. No sites referred all their patients to the optometrist.

The percentage failure rate between orthoptists and vision screeners trained by orthoptists using the PHE/BIOS package was quite close with orthoptists referring slightly more. Findings possibly suggest that both groups produce similar levels of false positives results and that the new online training initiative developed with PHE/NHS/BIOS (PHE & NHS, 2023) is working. Unfortunately, this hypothesis cannot be confirmed due to this year's data collection not including the information required to calculate this statistic. Nevertheless, it will be interesting to look at these figures in future years. The failure rate for vision screeners not trained by an orthoptist was higher by several percentage points. One potential explanation might be that vision screeners not trained by an orthoptist were more likely to refer false positive patients. Again however, this cannot be confirmed with this year's data collection due to the limitations outlined above. An alternative explanation might be the small sample size (n=1) means that we cannot extrapolate these figures to a wider context. The failure/referral rate for Scotland was slightly higher when compared to England. This difference was expected as all Scottish vision screeners carry out more tests and as a direct consequence have more failure criterion to increase their failure rate. Interestingly the sites that offered a second vision screening to those children that were borderline, failed slightly more than those who did not. This finding was surprising as you would expect fewer failures due to the opportunity of allowing them another opportunity to pass. Other confounding variables beyond those included in the current audit might explain this difference.

The main reason for referral across all the nations was failing the vision component in one or both eyes. Scotland had more children that failed due to the inclusion of the orthoptic tests that will detect orthoptic anomalies. All countries had a small number of children who they were unable to test. In Wales there was slightly more compared to the other countries. The numbers are very close to the figures reported in 2019-2020.

In order to facilitate the standardisation of vision screening across England, Public Health England guidance was published in October 2017 (PHE, 2017). In 2019-2020 67.9% of the sites adhered to this guideline. During 2020-2021 even more sites in England, appear to be compliant with the Public Health England requirements. Yet there is still more progress to make, before the service becomes fully standardised across the entire country. In Scotland 100% of orthoptist were compliant with NHS Scotland's guidelines.

Conclusion:

When looking at the data it should be remembered that the response rate is small (18.7%) and might consequently not be representative of the entire population. The sample is also likely to be biased in a positive direction as the data included are form sites that returned their vision screening audit and are possibly the sites most engaged with the vision screening process. In Scotland the return was 64.3%, it is therefore probable that their figures are more robust and comparable to their population. Despite this fact, considering the potential impact of the pandemic, it is encouraging to see the submission of so many returns during this academic year. A higher percentage of sites in England were conforming with PHE guidelines, on the other hand progress is still required in this area in order to make it fully standardised. The main method of gaining consent to screen, remains opt-out. This method ensured a fairly good coverage despite the closure of all schools for a period of many months. It is also promising to see a low percentage of parents and guardians decline the service. Possible reasons to decline again could be the pandemic itself or the fact that they are already receiving eye care. Once pandemic mitigations are removed, 100% of children are now being seen at the correct age across both England and Scotland. In total there were only 2 sites that were not orthoptists carrying out the vision screening themselves or vision screeners not trained by the recommended PHE/BIOS package. A few sites in England are still using Keeler with or without orthoptic tests. This means that they also use a pass criterion which is beyond what is recommended by PHE. In Scotland they are 100% compliant with their guidelines. The choice of whether to offer second screening to those initially unable to screen or those with a borderline vision is divided and requires further analysis to determine how it impacts levels of false positives. In England many children attend the hospital eye service once they have failed their vision screening in Scotland the majority of children attend either the hospital eye service (ophthalmologists or optometrists) or their high street optometrists once they have failed their vision screening.

References:

Baker, J. M., Drews-Botsch, C., Pfeiffer, M. R., & Curry, A. E. (2019). Driver licensing and motor vehicle crash rates among young adults with amblyopia and unilateral vision impairment. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *23*(4), 230–232. https://doi.org/10.1016/j.jaapos.2019.01.009

Bauer, A., Dietz, K., Kolling, G., Hart, W., & Schiefer, U. (2001). The relevance of stereopsis for motorists: a pilot study. *Graefe's Archive for Clinical and Experimental Ophthalmology*, *239*(6), 400–406. https://doi.org/10.1007/s004170100273

BBC. (2020, May 24). Coronavirus: Schools in England reopening on 1 June confirmed, PM says. *Https://Www.Bbc.Co.Uk/News/Education-52792769*.

Bruce, A., Fairley, L., Chambers, B., Wright, J., & Sheldon, T. A. (2016). Impact of visual acuity on developing literacy at age 4–5 years: a cohort-nested cross-sectional study. *BMJ Open*, *6*(2), e010434. https://doi.org/10.1136/bmjopen-2015-010434

Buckley, J. G., Panesar, G. K., MacLellan, M. J., Pacey, I. E., & Barrett, B. T. (2010). Changes to Control of Adaptive Gait in Individuals with Long-standing Reduced Stereoacuity. *Investigative Opthalmology & Visual Science*, *51*(5), 2487. https://doi.org/10.1167/iovs.09-3858

Gitsels, L. A., Cortina-Borja, M., & Rahi, J. S. (2020). Is amblyopia associated with school readiness and cognitive performance during early schooling? Findings from the Millennium Cohort Study. *PLOS ONE*, *15*(6), e0234414. https://doi.org/10.1371/journal.pone.0234414

gov.uk. (2023, January 20). *Population screening explained*. Https://Www.Gov.Uk/Guidance/Population-Screening-Explained.

Grant, S., & Conway, M. L. (2015). Reach-to-precision grasp deficits in amblyopia: Effects of object contrast and low visibility. *Vision Research*, *114*, 100–110. https://doi.org/10.1016/j.visres.2014.11.009

Grant, S., Suttle, C., Melmoth, D. R., Conway, M. L., & Sloper, J. J. (2014). Age- and Stereovision-Dependent Eye–Hand Coordination Deficits in Children With Amblyopia and Abnormal Binocularity. *Investigative Opthalmology & Visual Science*, *55*(9), 5687. https://doi.org/10.1167/iovs.14-14745

Institute for government. (2022, December 9). *Timeline of UK government coronovirus lockdowns and restrictions*.

Kanonidou, E., Gottlob, I., & Proudlock, F. A. (2014). The Effect of Font Size on Reading Performance in Strabismic Amblyopia: An Eye Movement Investigation. *Investigative Opthalmology & Visual Science*, *55*(1), 451. https://doi.org/10.1167/iovs.13-13257

Kanonidou, E., Proudlock, F. A., & Gottlob, I. (2010). Reading Strategies in Mild to Moderate Strabismic Amblyopia: An Eye Movement Investigation. *Investigative Opthalmology & Visual Science*, *51*(7), 3502. https://doi.org/10.1167/iovs.09-4236

Kelly, K. R., Jost, R. M., de La Cruz, A., & Birch, E. E. (2015). Amblyopic children read more slowly than controls under natural, binocular reading conditions. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *19*(6), 515–520. https://doi.org/10.1016/j.jaapos.2015.09.002

Kumaran, S. E., Khadka, J., Baker, R., & Pesudovs, K. (2019). Functional limitations recognised by adults with amblyopia and strabismus in daily life: a qualitative exploration. *Ophthalmic and Physiological Optics*, *39*(3), 131–140. https://doi.org/10.1111/opo.12610

Maag, U., Vanasse, C., Dionne, G., & Laberge-Nadeau, C. (1997). Taxi drivers' accidents: How binocular vision problems are related to their rate and severity in terms of the number of victims. *Accident Analysis & Prevention*, *29*(2), 217–224. https://doi.org/10.1016/S0001-4575(96)00075-9

NHS Scotland. (2019). *Pre-school Orthoptic Vision Screening (POVS) Scottish National Guidelines for Orthoptists*.

Packwood, E. A., Cruz, O. A., Rychwalski, P. J., & Keech, R. v. (1999). The psychosocial effects of amblyopia study. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *3*(1), 15–17. https://doi.org/10.1016/S1091-8531(99)70089-3

Pentland L, Patel S. Scottish Pre-School Vision Screening – First 3 Years of National Data. (2020) British and Irish Orthoptic Journal, **16(1)**:13–8.

PHE & NHS. (2023). *Child Vision Screening*. Https://Www.e-Lfh.Org.Uk/Programmes/Nhs-Screening-Programmes/.

Public Health England. (2017, October 27). *Service Specification*. Https://Www.Gov.Uk/Government/Publications/Child-Vision-Screening/Service-Specification.

Rahi, J. S., Cumberland, P. M., & Peckham, C. S. (2006). Does amblyopia affect educational, health, and social outcomes? Findings from 1958 British birth cohort. *BMJ*, *332*(7545), 820–825. https://doi.org/10.1136/bmj.38751.597963.AE

Solebo, L., Rahi, J. S., Epidemiology, O., & Ophthalmologist, H. C. (2013). *Vision screening in children aged 4-5 years Specialist Trainee in Ophthalmology*.

Tijtgat, P., Mazyn, L., de Laey, C., & Lenoir, M. (2008). The contribution of stereo vision to the control of braking. *Accident Analysis & Prevention*, *40*(2), 719–724. https://doi.org/10.1016/j.aap.2007.09.009

van Leeuwen, R., Eijkemans, M. J. C., Vingerling, J. R., Hofman, A., de Jong, P. T. V. M., & Simonsz, H. J. (2007). Risk of bilateral visual impairment in individuals with amblyopia: the Rotterdam study. *British Journal of Ophthalmology*, *91*(11), 1450–1451. https://doi.org/10.1136/bjo.2006.113670

Webber, A. L., Wood, J. M., Gole, G. A., & Brown, B. (2008). The Effect of Amblyopia on Fine Motor Skills in Children. *Investigative Opthalmology & Visual Science*, *49*(2), 594. https://doi.org/10.1167/iovs.07-0869

Appendix 1: BIOS School Vision Screening Audit Spreadsheet Code 2019-2020

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 L and will provide the basic information about the screening provided in your area.
- **Screening data 2019-2020** – this has columns A to L and is for the screening data for the academic year 2019- 2020 in your area. e.g., September 2019 to July 2020 in England and Wales
- **Area codes** – This contains the codes for each area

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 area code from the 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
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
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 * If 'set criteria based' explain in cell below K4
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

Worksheet 2: Screening Data for Sept 2019 - August 2020 (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	Number referred to HES	Number of children who failed the screening and referred to hospital eye service (HES)
G	Number referred to GOS	Number of children who failed the screening and referred to general ophthalmic service (GOS)
H - K	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
L	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

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

1. Screening offered to all children age 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 pass Criteria is 0.20 logMAR

Appendix 3 Criteria used to decide whether a site followed Scottish NHS guideline

1. Screening offered to all children age 4-5 years

2. Visual-Acuity tested with Keeler logMAR, the Sonksen logMAR or Kays Pictures crowded plus a battery of orthoptic tests to carry out vision screening.

3. Pass criteria vision better than 0.20 in both eyes with Keeler LogMAR and interocular difference < 3 letters. Alternatively, vision better than 0.10 in both eyes with either the Sonksen logMAR or Kays pictures crowded test or an interocular difference <3 letters. Nil significant manifest deviation, esophoria, decompensating heterophoria, ocular motility defect reduced convergence or poor motor fusion.

Appendix 4: BIOS Key Performance Indicators

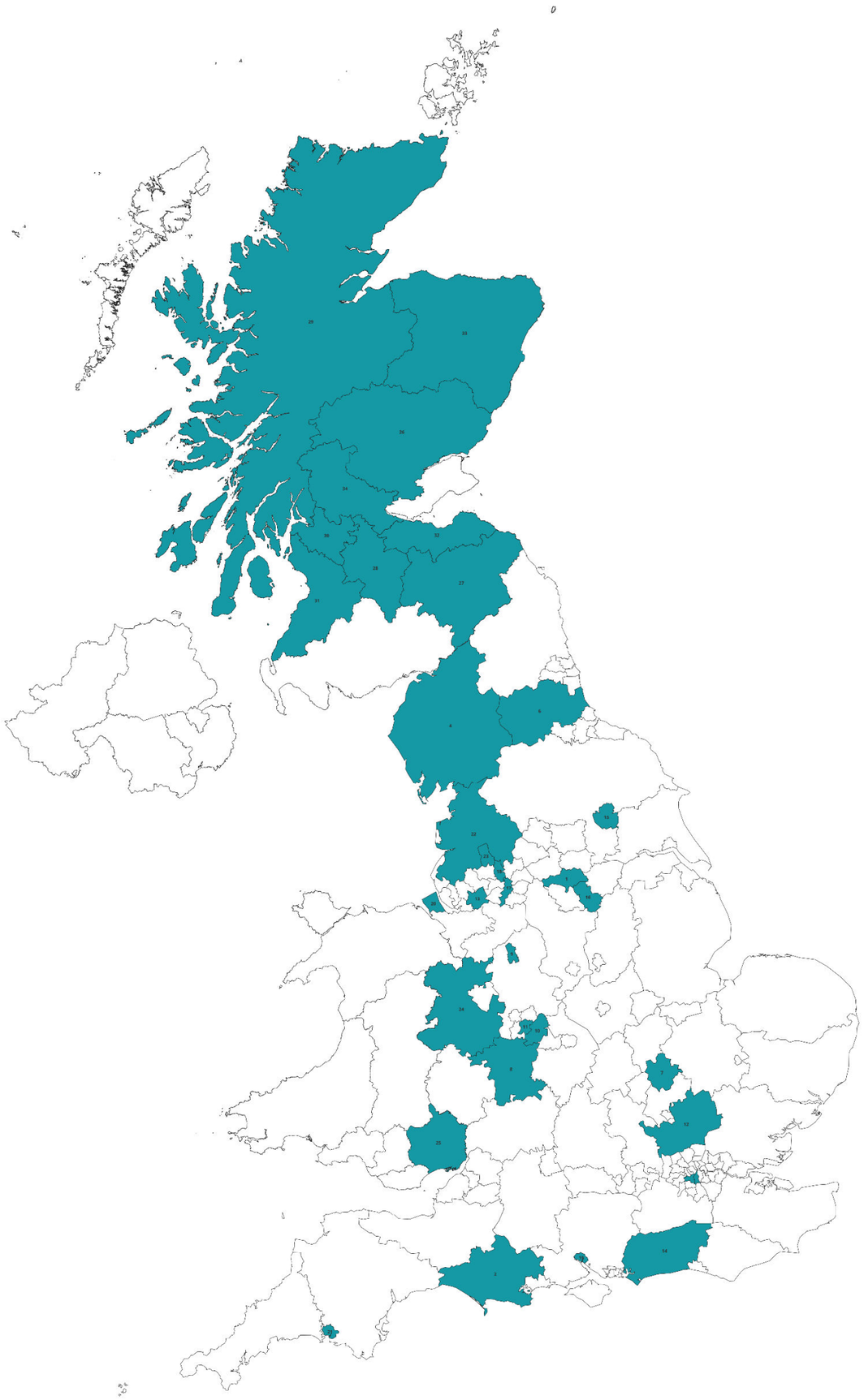
KP1: % of children who were screened

KP2: % of children Screened who were referred for an eye exam

KP3: of children referred who attended an eye exam (NOT COLLECTED)

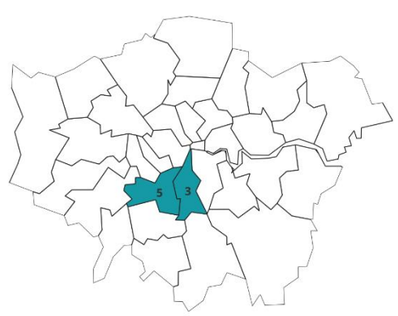
KP4: % True-positive referral rate (NOT COLLECTED)

	2017-2018	***2018-2019***	***2019-2020***
KP1	98%	92%	82.5%
KP2	13%	13%	15.2%
KP3	NP	NP	NP
KP4	NP	NP	NP



Appendix 5: List of sites contributing to the 2020-2021 audit

1. Barnsley
2. Dorset
3. Lambeth
4. Cumbria
5. Wandsworth
6. Durham & Darlington
7. Bedford, Central Beds and Luton
8. Worcestershire
9. Stoke on Trent
10. Birmingham
11. Sandwell and West Birmingham
12. Hereford
13. Warrington
14. West Sussex
15. York
16. Rotherham
17. Manchester
18. Bury
19. Southampton
20. Wirral
21. Plymouth
22. Lancashire
23. Blackburn with Darwen
24. Shropshire
25. Aneurin Bevan
26. Tayside
27. Borders
28. Lanarkshire
29. Highland
30. Greater Glasgow and Clyde
31. Ayrshire and Arran
32. Lothian
33. Grampian
34. Forth Valley



Where the location provided does not match a local authority, this has been approximated.

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