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Performance of candidates disclosing dyslexia with other candidates in a UK medical licensing examination: cross-sectional study

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ABSTRACT

Purpose of the study The aim of this study was to compare performance of candidates who declared an expert-confirmed diagnosis of dyslexia with all other candidates in the Applied Knowledge Test (AKT) of the Membership of the Royal College of General Practitioners licensing examination.

Study design We used routinely collected data from candidates who took the AKT on one or more occasions between 2010 and 2015. Multivariate logistic regression was used to analyse performance of candidates who declared dyslexia with all other candidates, adjusting for candidate characteristics known to be associated with examination success including age, sex, ethnicity, country of primary medical qualification, stage of training, number of attempts and time spent completing the test.

Results The analysis included data from 14 examinations involving 14 801 candidates of which 2.6% (379/14 801) declared dyslexia. The pass rate for candidates who declared dyslexia was 83.6% compared with 95.0% for other candidates. After adjusting for covariates linked to examination success including age, sex, ethnicity, country of primary medical qualification, stage of training, number of attempts and time spent completing the test dyslexia was not significantly associated with pass rates in the AKT. Candidates declaring dyslexia after initially failing the AKT were more likely to have a primary medical qualification outside the UK.

Conclusions Performance was similar in AKT candidates disclosing dyslexia with other candidates once covariates associated with examination success were adjusted for. Candidates declaring dyslexia after initially failing the AKT were more likely to have a primary medical qualification outside the UK.

INTRODUCTION

Dyslexia is a specific learning disability (SLD) that primarily affects skills involved in accurate and fluent word reading and spelling, which is known to affect test performance of those affected during school and academic careers.¹ Dyslexia affects around 6% of the population and around 2% of medical students in the UK.² The features indicative of dyslexia in adult learners are different to those in children³ and include general features such as low self-esteem, anxiety and frustration together with specific problems with recall, reading data, time management and task prioritisation under pressure,

and problems with attention, concentration or distractibility.⁴

Dyslexia and other disabilities are ‘protected characteristics’ under equality legislation (eg, the Equality Act 2010 in the UK) which means that examination bodies (like other public agencies) are required to provide equality of opportunity and eliminate unlawful discrimination. The possibility that able candidates with dyslexia are disadvantaged in postgraduate medical examinations, particularly those doctors seeking a licence to practise where examination failure will block further career progress, is a cause for concern for candidates, examination boards and regulators. We therefore sought for the first time to compare the performance of doctors declaring dyslexia with all other candidates taking a medical licensing examination.

The Applied Knowledge Test (AKT) is a mandatory, high-stakes computer-based knowledge test component of the medical licensing examination for UK general practice, the Membership of the Royal College of General Practitioners (MRCGP). Candidates who declare a diagnosis of dyslexia, confirmed by an accredited expert (specialist teacher with a practising certificate or a practising chartered or educational psychologist) when applying to take the examination, are offered reasonable adjustments (sometimes referred to as test accommodations) recommended by the expert for their disability, including extra time if required, which serve to reduce any potential disadvantage. The assessment is initiated by the candidate or their employer, and this sometimes occurs as a result of failing the AKT. Increasing numbers of candidates are declaring a diagnosis of dyslexia and although the number is small overall, for the individual candidate, the test accommodations such as additional time can be important.

Studies conducted on medical students have shown that medical knowledge tests do not systematically discriminate against those with dyslexia,^{5 6} but there have been no previous studies comparing performance in licensing examinations of medical doctors with or without dyslexia. The lack of studies in this area is partly due to the difficulty of researching this group of candidates due to small sample sizes, heterogeneity of SLDs and variation in test accommodations.⁷ Nevertheless, fairness is an important component of evidence of validity of tests.⁸



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We aimed in this study to compare performance, in a licensing examination for general practice, of candidates who declared they had dyslexia with all other candidates.

METHODS

We used a cross-sectional design with retrospective candidate data from 14 consecutive AKTs which took place between 2010 and 2015. We used the social model of disability as a conceptual framework for the study to direct our focus on solutions to any potential barriers which could restrict life choices for disabled people.⁹

Our null hypothesis was that there was no difference in performance comparing candidates who declared they had dyslexia compared with all other candidates in the AKT. The minimum sample size to find a small difference (Cohen's f_2 0.02) with eight predictors, power 80% and probability 0.05% was 755.¹⁰

The AKT is one of three components of the MRCGP examination,¹¹ the licensing examination for UK trained family doctors to certify their fitness for independent practice. The other components are a clinical skill assessment and a workplace-based assessment, which together assess the curriculum for specialty training for general practice.

The AKT is a 3-hour, 200-item multiple choice test, which assesses knowledge of clinical medicine (80%), evidence-based medicine (10%) and administrative issues (10%) relevant to UK general practice using single best answer, extended modified and a small number of free text question formats.¹² The AKT is scored out of 200 marks with each correct answer awarded 1 mark without differential weighting.¹²

Quality assurance of the test includes processes of question production, test construction, delivery and item analysis using classical test theory.¹³ The standard is set by the modified Angoff method and a set of 40 anchor items used for linear equating to maintain the standard between Angoff standard setting meetings (usually every 2 years). There is therefore good evidence for reliability and validity of the test based on test content, relationship variables of interest, structure and responses to items.¹²⁻¹⁴

Candidates who provide expert evidence that they have dyslexia are allowed reasonable adjustments recommended by the expert including additional time to complete the assessment (usually 25% additional time, ie, 45 min), although candidates who declare dyslexia do not always request or take additional time.

For each candidate, their examination scores and attributes (including age, sex, stage of specialty training within a 3-year full time programme, ethnic group, number of attempts and country of primary medical qualification) were provided by the MRCGP examination department. All data supplied were anonymised. Pass scores used were those set by the examination board for each AKT with the standard between the tests maintained using techniques described previously.¹²

Candidates were categorised according to the attributes listed above and whether they declared dyslexia. Candidates can declare dyslexia diagnosed by an expert at any point, either before entering their first AKT or prior to a subsequent attempt. We distinguished candidates who declared dyslexia before their first examination ('declared early') and those who declared the condition later, after failing at least one examination ('declared later').

We used multivariate logistic regression to investigate the association between passing the AKT and the declaration of dyslexia, adjusting for covariates known to be associated with differences in scores. Data were analysed using Stata V.14 employing a negative binomial regression because of the distribution of scores skewed towards passing candidates. Significance was determined

using a Bonferroni correction because of the number of comparisons involved. Missing data were not imputed or substituted in our analyses.

RESULTS

We included data from 14 851 candidates taken from 14 consecutive examinations: 379 (2.6%) candidates declared dyslexia, with 50 (0.3%) candidates opting not to declare SLD information, leaving 14 801 for the final analysis. Of the 379 candidates who declared dyslexia, 314 (82.8%) asked for and were granted specific accommodations including up to 50% extra time.

We used the following categories (percentages stated are proportions of the whole sample): age (under 30 years=46.7%, 30–39 years=44.5%, 40–49 years=8.0%, 50–80=0.8%), stage (or year) of general practice specialty training (ST1 (year 1)=0.0%, ST2 (year 2)=8.5%, ST3 (year 3)=15.6%, ST4 (year 4 or extended training)=0.3%, unknown/missing=75.6%), ethnicity (white=49.6%, Asian=34.9%, black=5.3%, mixed=2.5%, other=1.7%, unknown/missing=6.0%), number of attempts (first attempt=80.5%, second or third attempt=16.4%, fourth or more attempts=3.1%) and country of qualification (UK 75.3%, European Union and Russia 4.1%, rest of the world 19.4% and unknown 1.2%).

A significantly greater proportion of candidates declaring dyslexia were male, aged 30 years or over and had multiple attempts at the examination compared with candidates who did not declare dyslexia (table 1), who were more likely to be female, aged under 30 years and making their first attempt.

Most AKT candidates who declared dyslexia did so before their first attempt (239/379=63.1%), but this varied according to ethnicity and country of primary medical qualification of candidates. Candidates declaring dyslexia before taking the AKT for the first time were more likely to be white British doctors trained in the UK, whereas those making a declaration of dyslexia later, having initially failed the AKT, were more likely to be minority ethnic candidates with a primary medical qualification outside the UK (table 2).

Overall, 83.6% (317/379) candidates who declared dyslexia passed the AKT during the 14 examinations compared with 95.0% (13 702/14 422) candidates who did not declare dyslexia (table 3). This pass rate included more than one attempt at the examination. The pass rate for first time examination candidates declaring dyslexia early was 75.7% (181/239) compared with 83.0% (11 379/13 702) for those who never declared dyslexia.

We used multivariate logistic regression to investigate whether (early or late) declaration of dyslexia was independently associated with passing (or failing) the AKT adjusting for covariates known to affect performance (table 4). Candidates who were white, female, aged below 30 years, with a primary medical qualification from the UK were significantly more likely to pass the AKT. Male candidates, of black or Asian ethnic background, who had failed the examination at least once were less likely to pass the AKT. There was a strong negative association between the number of attempts and pass rate: candidates who failed once were more likely to fail thereafter. After taking these other factors into account, dyslexia was not associated with likelihood of passing the AKT.

DISCUSSION

Main findings

For the small proportion (2.6%) of those taking the AKT who declared a diagnosis of dyslexia, pass rates were *not* significantly

Table 1 Characteristics of Applied Knowledge Test candidates declaring dyslexia compared with all other candidates

Candidate characteristics	Dyslexia declared		Other candidates		P value
	n=379	(%)	n=14 422	(%)	
Sex					
Female	199	(52.5)	9004	(62.4)	P<0.001*
Male	178	(47.0)	5388	(37.4)	
missing	2	(0.5)	30	(0.2)	
Age (years)					
Under 30	144	(38.0)	6750	(46.8)	P<0.001†
30–39	174	(45.9)	6398	(44.4)	
40–50	47	(12.4)	1132	(7.8)	
51–80	11	(2.9)	109	(0.8)	
Missing	3	(0.8)	33	(0.2)	
Country of primary medical qualification					
UK	278	(73.4)	10 879	(75.4)	P=0.17†
EU and Russia	27	(7.1)	580	(4.0)	
Rest of the World	73	(19.3)	2806	(19.5)	
Unknown	1	(0.3)	157	(1.1)	
Ethnicity					
White British	183	(48.3)	7161	(49.7)	P=0.88†
Asian	129	(34.0)	5044	(35.0)	
Black	20	(5.3)	765	(5.3)	
Mixed	12	(3.2)	360	(2.5)	
Other	12	(3.2)	239	(1.7)	
Unknown	23	(6.1)	853	(5.9)	
Number of attempts					
One	192	(50.7)	11 727	(81.3)	P<0.001†
2–3	105	(27.7)	2317	(16.1)	
≥4	82	(21.6)	378	(2.6)	
Missing	0	(0.0)	0	(0.0)	
Stage of training					
ST2	28	(7.4)	1232	(8.5)	P=0.053†
ST3	86	(22.7)	2232	(15.5)	
ST4	1	(0.3)	37	(0.3)	
Missing	264	(69.7)	10 921	(75.7)	
Time taken					
<3 hours	22	(5.8)	7976	(55.3)	P<0.001†
3 hours	16	(4.2)	4681	(32.5)	
>3 hours	339	(89.4)	1734	(12.0)	
Missing	2	(0.5)	31	(0.2)	

*X².

†Kruskal-Wallis.

different compared with all other candidates after adjusting for covariates.

This study confirmed findings from previous studies that younger, female, white candidates and with a UK primary medical qualification were more likely to pass, whereas older, male candidates, of black or Asian ethnic background who had failed the examination at least once were significantly less likely to pass the AKT.^{15 16} Although these differences are well known, explanations are lacking¹⁷ and are the subject of ongoing research.¹⁸ For all candidates there was a strong negative association between the number of attempts and the pass rate: initial failure was associated with a higher risk of further failure so for candidates with a diagnosis of dyslexia after initial failing the examination, the likelihood of passing the AKT was already lower.

Table 2 Characteristics of candidates declaring dyslexia early versus late

Candidate characteristics	Dyslexia declared early		Dyslexia declared late		P value
	n=239 (63.1%)	(%)	n=140 (36.9%)	(%)	
Examination outcome					
Pass	210	(87.9)	107	(76.4)	P<0.01*
Fail	29	(12.1)	33	(23.6)	
Ethnicity					
White British	159	(66.5)	24	(17.1)	P<0.001†
Asian	54	(22.6)	75	(53.6)	
Black	4	(1.7)	16	(11.4)	
Mixed	7	(2.9)	5	(3.6)	
Other	3	(1.3)	9	(6.4)	
Unknown/missing	12	(5.0)	11	(7.9)	
Country of primary medical qualification					
UK	224	(93.7)	54	(38.6)	P<0.001†
Rest of the World	10	(4.2)	63	(45.0)	
EU and Russia	4	(1.7)	23	(16.4)	

*X².

†Kruskal-Wallis.

Candidates declaring dyslexia before taking the AKT for the first time were more likely to be white British doctors trained in the UK, whereas those making a declaration of dyslexia later, having initially failed the AKT, were more likely to be minority ethnic candidates with a primary medical qualification outside the UK.

Strengths and limitations

This was the first study comparing performance of candidates declaring dyslexia with other candidates in a licensing examination. We included a large number of candidates in 14 consecutive tests over 5 years. Recording rates for most candidate characteristics were good, and we accounted for these and other confounders in the analysis.

There were several limitations of the study. There were higher rates of missing data for stage of training and timing in the dataset. We did include time spent on the examination as a confounder which accounted for all candidates, including those with dyslexia and other disabilities who were provided with and took additional time in the examination. We did not include severity of dyslexia, additional disabilities and the detail of individual reasonable test adjustments in the analysis because these data were not available. The study was limited to a single knowledge test format in general practice in one developed country so our results therefore may not be generalised to knowledge tests in other specialties or other countries.

Comparison with existing literature

A number of difficulties are known to be experienced by adults with dyslexia that might affect their performance in multiple choice and computer-based tests such as the AKT. These include general issues with tests such as concentration, problem solving, information retention and retrieval, time management and organisation. There may also be specific problems with multiple choice examinations such as identifying important parts of a narrative, solving multistep problems or arithmetic manipulation. Computer-based tests introduce additional potential problems of visual distortion or glare.¹⁹ Adults with dyslexia

Table 3 Characteristics of candidates passing Applied Knowledge Test declaring dyslexia compared with all other candidates

Candidate characteristics	Dyslexia declared		Other candidates		P value
	n=317	(%)	n=13 702	(%)	
Sex					
Female	170	(53.6)	8636	(63.0)	P<0.001*
Male	147	(46.4)	5066	(37.0)	
Age (years)					
Under 30	135	(42.6)	6617	(48.3)	P<0.018†
30–39	141	(44.5)	6018	(43.9)	
40–50	32	(10.1)	979	(7.1)	
51–80	8	(2.5)	85	(0.6)	
Missing	1	(0.3)	3	(0.0)	
Country of primary medical qualification					
EU and Russia	15	(4.7)	505	(3.7)	P=0.8†
Rest of the world	55	(17.4)	2506	(18.3)	
UK	246	(77.6)	10 559	(77.1)	
Missing	1	(0.3)	132	(1.0)	
Ethnicity					
White British	168	(53)	7036	(51.4)	P=0.5†
Asian	101	(31.9)	4642	(33.9)	
Black	12	(3.8)	668	(4.9)	
Mixed	10	(3.2)	348	(2.5)	
Other	7	(2.2)	219	(1.6)	
Unknown	19	(6.0)	789	(5.8)	
Number of attempts					
One	181	(57.1)	11 379	(83.0)	P<0.001†
2–3	80	(25.2)	2045	(14.9)	
≥4	56	(17.7)	278	(2.0)	
Stage of training					
ST2	23	(7.3)	1172	(8.6)	P<0.051†
ST3	65	(20.5)	1863	(13.6)	
ST4	1	(0.3)	37	(0.3)	
Missing	228	(71.9)	10 630	(77.6)	
Time taken					
<3 hours	19	(6.0)	7817	(57.1)	P<0.001†
3 hours	15	(4.7)	4433	(32.4)	
>3 hours	283	(89.3)	1451	(10.6)	
Missing	0	(0.0)	1	(0.0)	

* χ^2 .

†Kruskal-Wallis.

are known to have moderate to large differences in measures of cognition, verbal memory and maths compared with people without dyslexia, but these differences are moderated by abilities in verbal intelligence, vocabulary, spelling and specific cognitive processes.²⁰

The AKT and the MRCGP seek to differentiate between candidates 'only in terms of the abilities, knowledge and skills that are the subject of the assessment' to ensure fairness to all candidates. Processes in place to prevent unlawful discrimination, for example, under the UK Equalities Act (2010) and the Public Sector Equality Duty that arises from this in the UK, include equalities policies, monitoring and appeals procedures, together with provision for candidates to request reasonable adjustments, whether temporary or permanent.¹¹

Extended time adjustments are known to benefit those with dyslexia, but additional time has also been found to change test item performance and, to benefit, although to a lesser extent, those without dyslexia or other SLDs.^{21 22} This has important

Table 4 Multivariate logistic regression showing factors associated with passing the Applied Knowledge Test

Candidate characteristics	Coefficient	95% CI	P value
Number of examination attempts			
One	Reference		
Two	−0.08	(−0.13 to −0.03)	P<0.0025
Three	−0.02	(−0.09 to 0.04)	P=0.47
Four	−0.05	(−0.15 to 0.05)	P=0.34
Five or more	−0.22	(−0.38 to −0.05)	P=0.01
Ethnicity			
White British	Reference		
Asian	−0.10	(−0.13 to −0.07)	P<0.0025
Black	−0.14	(−0.23 to −0.06)	P<0.0025
Mixed	−0.01	(−0.06 to 0.05)	P=0.84
Other	−0.18	(−0.34 to −0.03)	P=0.02
Country of primary medical qualification			
UK	Reference		
Rest of the World	−0.08	(−0.13 to −0.03)	P<0.0025
EU and Russia	−0.13	(−0.22 to −0.04)	P<0.0025
Age (years)			
<30	Reference		
30–39	−0.04	(−0.06 to −0.02)	P<0.0025
40–50	−0.15	(−0.22 to −0.08)	P<0.0025
51–80	−0.37	(−0.7 to −0.04)	P=0.03
Sex			
Female	Reference		
Male	−0.03	(−0.06 to 0)	P=0.05
Stage of training			
ST2	Reference		
ST3	−0.12	(−0.14 to −0.09)	P<0.0025
Time taken			
<3 hours	Reference		
=3 hours	0	(−0.03 to 0.02)	P=0.78
>3 hours	−0.09	(−0.12 to −0.06)	P<0.0025
Dyslexia declared or not declared			
Dyslexia not declared	Reference		
Dyslexia declared early	0.08	(−0.14 to 0.3)	P=0.49
Dyslexia declared late	0	(−0.11 to 0.09)	P=0.81

Positive values indicate more likely to pass. P=0.0025 for Bonferroni correction (significant results in bold).

implications for fairness and validity in tests, and in particular in high-stakes licensing examinations such as the AKT.⁷ For example, some experts argue that this should lead to all candidates being offered additional time, although this has to be offset against the feasibility and costs of doing this.²³

Our finding that dyslexia was not associated with a greater likelihood of passing (or failing) the AKT, once other covariates had been adjusted for, corresponds with the lack of difference found in performance between UK medical students with or without dyslexia.^{5 6} Although differences in AKT performance by candidate sex, ethnicity and country of primary medical qualification have been found previously,^{15 16} it was of interest that doctors from ethnic minorities or trained outside the UK were more likely to declare dyslexia after failing the AKT.

Candidates from overseas may be less likely to have been diagnosed during their school or university education due to lack of testing for dyslexia at an earlier stage in their education overseas. Later diagnosis in International Medical Graduates (IMGs)

after initially failing the test may explain the proportion of doctors taking the AKT who declare dyslexia which has gradually increased from 1.5% in 2011–2012 to 5.5% in 2014–2015.² This also raises questions about the reliability of the diagnosis of dyslexia in candidates who use English as an additional language since there are no nationally documented standards for this.

Implications for policy, practice and research

Implications of our findings are discussed in relation to the social model of disability, the theoretical framework for this study which seeks to promote fairness, reduce barriers and improve life choices for people with a disability.⁹

Doctors with dyslexia may have difficulty writing and calculating prescriptions, completing patient records and prioritising or making referral decisions. Identifying dyslexia, enabling doctors to disclose the condition early, offering screening and testing, providing educational strategies to support those affected and challenging negative assumptions are important for an 'enabling' environment.^{2,24}

Barriers to testing during vocational training include barriers with the candidate such as lack of recognition by the GP specialty trainee themselves, reluctance to disclose because of the stigma associated with the diagnosis and concerns that this might affect be an excuse for underperformance or affect future career progress⁴; barriers within the training scheme including a lack of facilities for screening, or policies for screening only when candidates have failed the AKT,³ may signify the absence of a proactive approach to detection or management.

Screening tests for dyslexia can be affected by language making assessment more difficult, although the vast majority of candidates taking the AKT reported that English was their preferred language. There is no strong practice-based evidence on assessment of doctors where English is not their first language, but such assessments should nevertheless be conducted by an expert using a range of evidence.²⁵

Screening for dyslexia is not routinely provided by deaneries, who are responsible for training GPs, and an independent assessment by an approved psychologist can be expensive (£500 or more), which may deter candidates from seeking an evaluation.²⁶

There are implications for trainees, those responsible for training and those responsible for assessment. Educators should provide a supportive, non-judgemental and positive attitude towards trainees with suspected and actual SLDs.²⁷

Training schemes and deaneries should consider whether earlier screening, and where evidence of SLD is present, of a detailed assessment should be provided for the trainee at no or reduced cost. Small-scale evaluations have shown the success of this approach in other clinical settings.²⁸ Screening may be particularly important for doctors from minority ethnic groups who may not have been assessed earlier in their educational or academic career. The costs of this assessment may be offset by costs to candidates and the examination board of retaking the test and costs for deaneries, responsible for specialist training, to extend the training period for doctors who have failed the test.

Candidates with dyslexia are not automatically provided additional time in the AKT as their requirements may differ. The RCGP will follow the guidance of the expert report on the necessary accommodations which can include different fonts and colour screens and up to 50% additional time. Candidates with SLDs should continue to be allowed reasonable adjustments, recommended by experts and tailored according to individual need. Licensing bodies need to consider candidates from groups with protected characteristics, including those with specific

learning or other disabilities, when designing examination items, formats and arrangements.

Further research is needed to identify the extent to which adjustments for examinations alter the skill being measured, affect the meaning of scores compared with those obtained under standard conditions or disadvantage candidates without disabilities. It is important to ensure that diagnoses of SLDs and test accommodations are reliably and validly determined, and to understand to what extent disabled candidates can adapt to standard test conditions.²⁹

Monitoring for differential performance is important to ensure valid and fair licensing examinations for all candidates, but differences in performance need to be analysed carefully taking into account the many possible reasons for these. In terms of test reliability and validity, further work could be done on the effect of test content and format for candidates with SLDs to understand if particular questions or formats are answered differently resulting in differential item functioning or altered item–test correlations, and, if so, why.⁷

CONCLUSIONS

We found comparable pass rates for candidates with dyslexia compared with other candidates. It is important for examination bodies, particularly those administering high-stakes licensing examinations, to review pass rates for candidates with disabilities, including SLDs such as dyslexia, to ensure that the test is fair to all candidates.

Other covariates associated with examination success should be taken into account when assessing differences in performance in candidates with specific learning difficulties such as dyslexia.

Specialty training programmes should create an environment where doctors with dyslexia are actively identified or self-identified and where help is sought and provided for more timely assessment and educational support, with reasonable accommodations arranged for examinations.

Main messages

Dyslexia was not associated with lower pass rates in the Applied Knowledge Test (AKT) after adjusting for other factors linked to examination success. Candidates declaring dyslexia after initially failing the AKT were more likely to have a primary medical qualification outside the UK. We advocate more consistent dyslexia screening during undergraduate and postgraduate medical training.

Current research questions

- ▶ How should International Medical Graduates be assessed for dyslexia?
- ▶ What is the approach of different deaneries to identifying and supporting doctors with dyslexia?
- ▶ What test content and format is problematic for candidates with dyslexia?

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Contributors ANS led the study, was responsible for the initial design and supervised the analysis carried out by ZBA. The initial draft of the paper was written by ZBA and ANS. All the remaining authors (CE, JR, JL, AS, KAN, DS, CB) contributed to the conception and design of the study, revision and final approval of the paper.

All authors agree to be accountable for all aspects of the accuracy and integrity of the study.

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Details: Khyati Morjaria, School of Life Sciences, University of Warwick, Coventry, CV4 7AL, UK (Tel: 024 765 75267; email: K.Morjaria@warwick.ac.uk; website: <https://warwick.ac.uk/fac/sci/lifesci/study/shortcourses/immunology>).