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Evaluation of recruitment and selection for specialty training in public health: Interim results of study to measure the predictive validity of the selection process.

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3 **Evaluation of recruitment and selection for specialty training in public health:**
4 **Interim results of a prospective cohort study to measure the predictive validity**
5 **of the selection process.**
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Abstract

Background

The recruitment process for public health specialty training includes an Assessment Centre (AC) with three components, Rust Advanced Numerical Reasoning Appraisal (RANRA), Watson-Glaser Critical Thinking Appraisal (WGCT), and a Situation Judgement Test (SJT), which determines invitation to a Selection Centre (SC). The scores are combined into a total recruitment (TR) score which determines the offers of appointment.

Methods

A prospective cohort study using anonymous record linkage to investigate the association between applicant's scores in the recruitment process and registrar's progress through training measured by results of Membership Faculty Public Health (MFPH) examinations and outcomes of the Annual Review of Competence Progression (ARCP).

Results

Higher scores in RANRA, WGCT, AC, SC, and TR were all significantly associated with higher adjusted odds of passing Part A MFPH exam at the first attempt. Higher scores in AC, SC, and TR were significantly associated with passing Part B exam at the first attempt. Higher scores in SJT, AC, and SC were significantly associated with satisfactory ARCP outcomes.

Conclusions

The current UK national recruitment and selection process for public health specialty training has good predictive validity. The individual components of the process are testing different skills and abilities and together they are providing additive value.

200 Words

Introduction

General Medical Council (GMC) standards for speciality training require that the processes for recruitment, selection and appointment must be open, fair, and effective¹. Evaluation is required to demonstrate the effectiveness of the recruitment and selection process. One measure of effectiveness is the predictive validity of the selection process, that is, the extent to which the process predicts applicants' future performance on criterion of interest. The intention of selection and recruitment is to identify applicants who will successfully complete training and excel in subsequent practice.

The UK public health specialty training scheme is a five year training scheme leading to registration as a public health specialist with the GMC or UK Public Health Register (UKPHR), and meet the requirements to work in consultant level senior public health posts within the UK². Historically recruitment was undertaken at local Deanery level, but in 2009 a national recruitment and selection process was introduced. This consists of a two stage competency-based process, explicitly linked to a detailed person specification. Detailed development work was undertaken mapping the key competences and attributes required in the person specification for the role as a consultant in public health, and a recruitment process designed to ensure that these were all systematically tested during the recruitment process.

The first stage, assessment centre (AC), is comprised of two cognitive ability tests, which measure numerical (Rust Advanced Numerical Reasoning Appraisal test) and verbal reasoning (Watson Glaser Critical Thinking test). A situational judgment test developed specifically for use in the public health context was added in 2011. Progression to the second stage, selection centre (SC), requires applicants to pass the threshold score for each of the three tests and those with the highest combined scores are invited to the selection centre. The SC has three components; a group exercise, a written test, and a series of short interview panels. Figure 1 shows a summary of the recruitment and selection process.

We report the interim results of a prospective cohort study set up to measure the predictive validity of the recruitment process as a whole, and its individual components, on public health specialty registrars progress through speciality training.

Methods

The evaluation used a prospective cohort study design, all specialty registrars who took up an appointment to a training scheme in England and Wales following recruitment in one of the four annual recruitment rounds between 2009 and 2012 were included in the study. Applicants were given information about the planned long-term evaluation at the time of recruitment. Follow up for this interim analysis was until December 2014.

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3 Follow up was undertaken by anonymous record linkage. Health Education East
4 Midlands (HEEM), the lead organisation for public health national recruitment,
5 allocated each applicant a unique anonymous identifier. The applicant's basic
6 demographic details and scores for each part of the recruitment process were
7 provided to the evaluation team with this unique anonymous identifier. HEEM
8 provided the Faculty of Public Health (FPH) with details of applicants who were
9 offered a post and their unique anonymous identifier. The FPH provided the
10 evaluation team with outcome data with the unique anonymous identifier.
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14 The "exposure" or predictor variables for the cohort available from the recruitment
15 process were: T-scores standardised to the public health norm group for Rust
16 Advanced Numerical Reasoning Appraisal (RANRA)³; Watson-Glaser Critical
17 Thinking Appraisal (WGCT)⁴; and the T-score for a bespoke Situation Judgement
18 Test (SJT) for Public Health for 2011 and 2012; and, the total overall score for the
19 selection centre (SC score). A combined score from the assessment centre tests
20 (AC score) and a total combined score for the whole recruitment process (TR score)
21 was calculated.
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25 The criterion measures or "outcomes" used to indicate progress through speciality
26 training were: full pass at the first attempt after starting speciality training of the
27 Membership of the Faculty of Public Health (MFPH) Part A examination; pass at the
28 first attempt after starting speciality training of the MFPH Part B examination; and, a
29 satisfactory outcome of the Annual Review of Competence Progression (ARCP)⁵
30 defined as no recorded ARCP outcomes 2, 3, 4 or 5 (Supplementary Table S1).
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34 Data on potential confounding factors, age, sex, ethnicity, and professional
35 background (medical or other background) were obtained as part of the application
36 process. The study size was determined by the number of registrars appointed to the
37 training programmes and an a priori power calculation was performed. For a power
38 of 80% at 5% significance level and the observed difference in proportions of
39 candidates with higher AC score passing membership exam, a minimum sample size
40 of 206 applicants are required.
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43 *Predictive validity*

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45 The predictor variables were categorised into below and above 50th percentile
46 (median) groups. In bivariate analysis the association between demographic
47 variables and the predictor and outcome variables was investigated.
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50 The predictive validity of the standardised scores of each of the three AC tests
51 (RANRA, WGCT, SJT), the AC score, SC score and TR score were examined.
52 Logistic regression analyses were used to estimate the odds of passing Part A and
53 Part B exam on the first attempt and having satisfactory ARCP outcomes. The
54 predictor variables were analysed as both categorical and continuous with
55 adjustment for potential confounders. The logistic regression analysis was not
56 corrected for range restriction.
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Receiver Operator Characteristic (ROC) analyses were used to study the ability of each of the components of the recruitment process separately and combined to discriminate between registrars likely to perform well in training, as demonstrated by passing membership examinations from the first attempt and having satisfactory outcomes of ARCPs. The discriminatory accuracy can be measured by the area under the receiver operator characteristic curve (AUC_{-ROC}). AUC_{-ROC} is the probability that a test correctly identifies an individual who will perform well in training from a pair of whom one will perform well and one will not. AUC_{-ROC} values range from 0.5 (total lack of discrimination) to 1.0 (perfect discrimination).

Individuals with missing data were excluded from any analysis which required the missing data. $P < 0.05$ was considered statistically significant. Data analysis was done using STATA 13.

Results

The cohort was comprised of 274 registrars who took up an appointment after applying between 2009 and 2012. The number recruited in each consecutive year was 74, 76, 76 and 48. Demographic data were available for almost all applicants. Of these, the mean age (SD) was 33 (6) years; range: 25-50 years, 73% (197/271) were women, 86% (223/259) described themselves as White or White British and 37% (101/271) applied as registered medical practitioners.

Nineteen registrars had passed Part A MFPH and seven had passed Part B MFPH prior to taking up appointment. Eighty six percent (236/274) of registrars had sat Part A MFPH since joining a training scheme, of whom 58% (137/236) achieved a full pass at the first attempt. Sixty seven percent (188/274) of registrars had sat Part B MFPH since joining a training scheme, of whom 90% (169/188) passed at the first attempt. Overall 212 registrars had at least one ARCP record, of whom 84% (179/212) had satisfactory ARCP outcomes recorded.

The cohort's scores in the component and combined components of the recruitment process, the predictor variables, are summarised in supplementary Table S2. The association between demographic characteristics and the predictor and outcome variables are summarised in supplementary Table S3.

Higher scores in Rust Advanced Numerical Reasoning Appraisal (RANRA), Watson-Glaser Critical Thinking Appraisal (WGCT), Assessment Center (AC), Selection Center (SC), and Total Recruitment (TR) were all significantly associated with higher odds of passing Part A exam at the first attempt. There was 12% increase in odds of passing Part A exam for every one point increase in the TR score ($OR_{-trend} = 1.12$, 95% CI 1.05-1.19) (Table 1).

There was almost four fold increase in the odds of passing Part B exam at the first attempt with higher AC score ($OR_{-adjusted} = 4.12$, 95% CI 1.27-13.37), SC score

(OR-adjusted =4.28, 95% CI 1.40-13.09), and TR score (OR-adjusted=3.87, 95% CI 1.27-11.78) (Table 2).

Higher Situational Judgement Test (SJT) score, SC score and AC score were associated with statistically significant higher odds of having satisfactory ARCP outcome (Table 3). However, given the small sample size of the recruited applicants with SJT and ARCP outcome, the confidence intervals are wide.

The Area Under the Curve (AUC) from Receiver Operating Characteristic (ROC) analyses for the independent predictor variables for the progression through training outcomes are presented in Table 4. For Part A exam, RANRA, WGCT, AC, SC, and TR scores have fair discrimination, with AUC for AC was 0.62 (95% CI 0.55-0.70) and of AC and SC combined was 0.66 (95% CI 0.59-0.73). Although AC and SC did not show statistically significant discrimination for Part B exam, AC and SC combined showed statistically significant fair discrimination (AUC=0.64, 95% CI 0.56-0.74). For ARCP, SC score but not AC showed statistically significant discrimination (SC-AUC =0.65 95% CI 0.55-0.75). Despite the relatively small sample size, SJT had statistically significantly better discrimination of candidates with satisfactory ARCP outcome (AUC 0.73 95%CI 0.52-0.94).

Discussion

Main finding of this study

This is the first study that has explored the predictive validity of the UK recruitment and selection process for specialty training in public health. The recruitment and selection process for public health specialty training demonstrates good predictive value with higher scores in the process clearly associated with the likelihood of registrars passing key professional exams in a timely manner. The overall weighted Assessment Center (AC) score is a better predictor than individual AC tests, and the overall weighted Total Recruitment (TR) score is better predictor than the AC score or Selection Center (SC) score separately. While the cognitive ability tests, Rust Advanced Numerical Reasoning Appraisal (RANRA) and Watson-Glaser Critical Thinking Appraisal (WGCT), predict exam performance, Situation Judgement Test (SJT) and SC predict overall performance in training. This suggests that the individual components of the recruitment process are testing different skills and abilities or “constructs” and that together they are providing additive value. Although each component of the recruitment process adds to the cost of recruitment this can be justified by the increase in predictive validity added by each component.

What is already known on this topic

The use of standardised test and approaches is helpful in ensuring quality during recruitment processes with respect to fairness and reliability. There is empirical

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3 evidence from other postgraduate medical recruitment processes that the use of
4 standardised tests and approaches in recruitment is also valid in terms of predicting
5 performance. Recruitment for UK general practice training combines short listing
6 applicants, using clinical problem solving skill and situational judgment tests, with a
7 selection centre which uses job-relevant simulations (patient consultation, group and
8 written simulation exercises), to measure both clinical and non-clinical attributes ⁶.
9 Evaluation has demonstrated that each of these selection methods is a significant
10 independent predictor of trainee performance 1 year into training assessed by
11 educational supervisors and performance at the end of training assessed by final
12 Royal College of General Practitioners membership examination ^{6 7 8}. In anaesthetic
13 recruitment a structured selection centre predicted performance during the first year
14 of training assessed by multiple work place based assessment ⁹.
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19 Registrars less than 31 years of age were significantly more likely to pass Part A
20 MFPH at the first attempt, and registrars who described themselves as White/British
21 were more likely to pass Part B MFPH at the first attempt (Table S3). The higher Part
22 A pass rate might be explained by the higher scores in most components of the
23 selection process achieved by younger applicants. Black and minority ethnic doctors
24 are less likely to pass postgraduate examination than white doctors ¹⁰. Further work
25 is required to determine the possible causes of those differences.
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29 What this study adds

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31 This study adds to the body of evidence and shows that recruitment and selection
32 processes within postgraduate medical training that involves standardized tests and
33 approaches, are valid in terms of the longer term outcomes and performance in the
34 workplace during training.
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37 Limitations of this study

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39 Whilst there may be debate as to whether passing professional examinations is a
40 good proxy for performance in the workplace, there is no doubt that failure to pass
41 relevant examinations in a timely fashion is a key problem in terms of progression
42 and performance for registrars on training programmes. There is currently no overall
43 metric of performance other than examination and ARCP outcomes that is routinely
44 collected.
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47 Although the numbers in this study are modest, they represent the entire cohort of
48 specialty registrars appointed in this four-year period. The study was able to find
49 significant associations with the predictor variables and outcomes despite its limited
50 size. The small sample size was a particular issue for investigating the SJT, for
51 which only 2 years data was available, and outcomes later in training such as the
52 Part B MFPH examination. Follow up of this cohort over a longer period of time, and
53 extension of the cohort to include individuals appointed in later years would be
54 desirable and is planned.
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Conclusion

The interim results indicate that the current UK national recruitment and selection process for public health specialty training has good predictive validity of satisfactory progress through training.

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3 Conflict of interest:

4
5 NP, SG, CD, JP, DW, FP, AK, and BM were involved in the development of the
6 national recruitment process. NP, SG, CD, JP, DW, and BM have been involved with
7 or led delivery of the national recruitment process. FP and AK provided advice to
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10 Psychology Group Ltd.
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14
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Figure legend

Figure 1. Schematic diagram of the stages of recruitment process into specialty training in public health

For Peer Review

Table 1. Odds ratios and adjusted odds ratios for passing membership examination Part A for cohort of registrars recruited between 2009 and 2012.

Predictor variable	Pass	Fail	OR-trend*	95% CI	OR	95% CI	Adjusted OR #	95%CI
Part A examination	N=137	N=99					N=228	
RANRA			1.05	1.01-1.09				
RANRA < 56	53	61			1.00		1.00	
RANRA ≥ 56	84	38			2.54	1.50-4.33	2.63	1.50-4.61
WGCT			1.06	1.02-1.11				
WGCT < 59	52	56			1.00		1.00	
WGCT ≥ 59	85	43			2.13	1.26-3.60	2.14	1.21-3.79
SJT N=103			1.01	0.91-1.12				
SJT < 58	26	20			1.00		1.00	
SJT ≥ 58	33	24			1.06	0.48-2.32	1.05	0.44-2.49
AC score			1.08	1.03-1.13				
AC < 58	58	63			1.00		1.00	
AC ≥ 58	79	36			2.38	1.40-4.06	2.43	1.37-4.30
SC score			1.07	1.02-1.13				
SC < 58	59	60			1.00		1.00	
SC ≥ 58	78	39			2.03	1.20-3.44	1.88	1.09-3.24
Total Recruitment			1.12	1.05-1.19				
TR < 58	57	63			1.00		1.00	
TR ≥ 58	80	36			2.46	1.44-4.18	2.27	1.31-3.93

*OR-trend – the independent variables are continuous

Adjusted for age, sex, ethnicity and professional background

Table 2. Odds ratios and adjusted odds ratios for passing membership examination Part B for cohort of registrars recruited between 2009 and 2012.

Predictor variable	Pass	Fail	OR-trend*	95% CI	OR	95% CI	Adjusted OR #	95%CI
Part B examination	N=169	N=19					N=181	
RANRA			1.05	0.98-1.12				
RANRA < 56	74	12			1.00		1.00	
RANRA ≥ 56	95	7			2.20	0.83-5.87	2.25	0.79-6.43
WGCT			1.04	0.97-1.12				
WGCT < 59	74	10			1.00		1.00	
WGCT ≥ 59	95	9			1.43	0.55-3.69	1.25	0.44-3.54
SJT N=77			1.11	0.91-1.34				
SJT < 58	30	5			1.00		1.00	
SJT ≥ 58	40	2			3.33	0.60-18.37	2.66	0.43-16.57
AC score			1.07	0.99-1.16				
AC < 58	74	14			1.00		1.00	
AC ≥ 58	95	5			3.59	1.24-10.43	4.12	1.27-13.37
SC score			1.08	0.98-1.18				
SC < 58	73	13			1.00		1.00	
SC ≥ 58	96	6			2.85	1.03-7.86	4.28	1.40-13.09
TR score			1.12	1.00-1.25				
TR < 58	73	13			1.00		1.00	
TR ≥ 58	96	6			2.85	1.03-7.86	3.87	1.27-11.78

*OR-trend – the independent variables are continuous

Adjusted for age, sex, ethnicity and professional background

Table 3. Odds ratios and adjusted odds ratios for having satisfactory ARCP outcome for cohort of registrars recruited between 2009 and 2012.

Predictor variable	Pass	Fail	OR-trend*	95% CI	OR	95% CI	Adjusted OR #	95%CI
ARCP N=212	N=179	N=33						
RANRA			1.01	0.96-1.07				
RANRA < 56	90	20			1.00		1.00	
RANRA ≥ 56	89	13			1.84	0.83-4.06	2.22	0.99-5.20
WGCT			1.05	1.00-1.11				
WGCT < 59	80	16			1.00		1.00	
WGCT ≥ 59	99	17			1.16	0.54-2.48	1.43	0.62-3.27
SJT N=83			1.23	0.98-1.54				
SJT < 58	30	6			1.00		1.00	
SJT ≥ 58	45	2			3.63	0.66-19.91	9.88	1.20-81.51
AC score			1.05	0.98-1.12				
AC < 58	86	22			1.00		1.00	
AC ≥ 58	93	11			2.27	1.01-5.09	3.45	1.41-8.46
SC score			1.09	1.01-1.17				
SC < 58	83	22			1.00		1.00	
SC ≥ 58	96	11			2.05	0.93-4.53	2.41	1.05-5.52
TR score			1.12	1.02-1.23				
TR < 58	85	21			1.00		1.00	
TR ≥ 58	94	12			1.71	0.78-3.73	1.99	0.89-4.49

*OR-trend – the independent variables are continuous

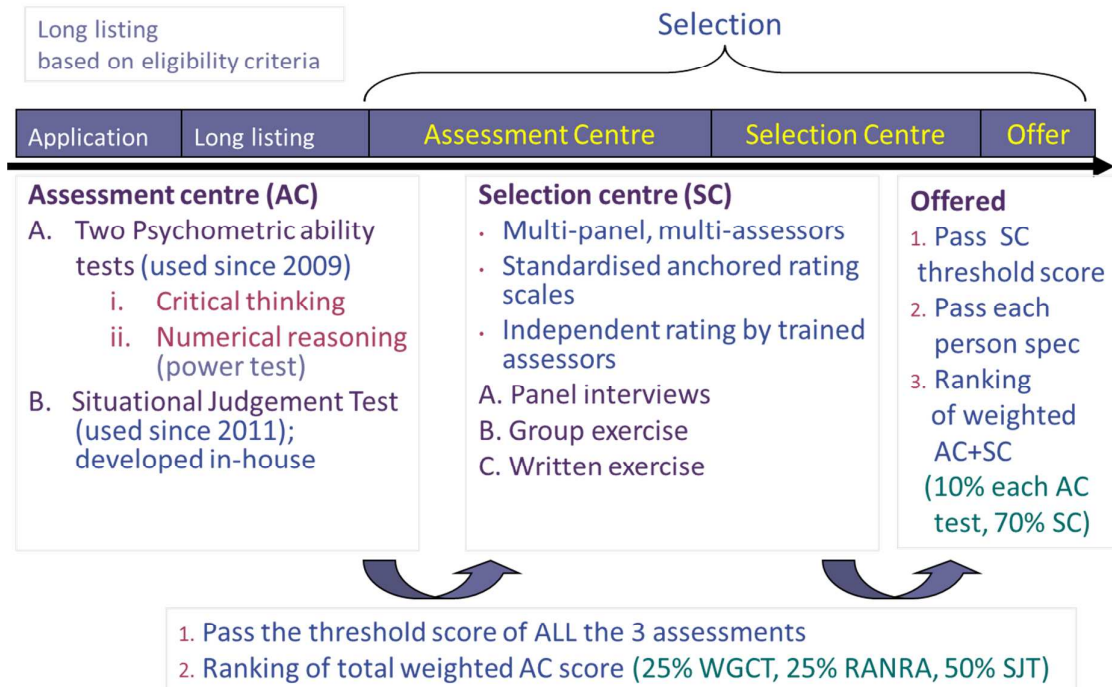
Adjusted for age, sex, ethnicity and professional background

Table 4: Receiver Operating Characteristic analysis to show how well the individual and combined components of the recruitment discriminate between candidates likely to pass or not membership examinations and have ARCP outcome as satisfactory or not.

Training outcomes						
Predictor variable	Part A Membership exam		Part B Membership exam		Satisfactory ARCP Outcome	
	N=236		N=188		N=212	
	AUC	95% CI	AUC	95% CI	AUC	95% CI
RANRA	0.60	0.53-0.68	0.60	0.46-0.74	0.53	0.42-0.64
WGCT	0.60	0.52-0.67	0.57	0.43-0.70	0.57	0.47-0.68
SJT score *	0.53	0.41-0.64	0.64	0.47-0.80	0.73	0.52-0.94
AC score	0.62	0.55-0.70	0.62	0.49-0.75	0.57	0.46-0.69
SC score	0.61	0.54-0.68	0.62	0.49-0.76	0.65	0.55-0.75
TR score	0.64	0.57-0.71	0.65	0.52-0.78	0.66	0.56-0.76
AC and SC combined	0.66	0.59-0.73	0.64	0.56-0.73	0.62	0.55-0.71
AC, SC, and demographics	0.68	0.61-0.75	0.58	0.50-0.67	0.62	0.54-0.70

* N=103 registrars with Part A exam; 77 with OSPHE; 83 with ARCP record

Figure 1. Schematic diagram of the stages of recruitment process into specialty training in public health



Description of additional data files

File name: Supplementary File

File format: Microsoft Word 2010

Title of data:

- Supplementary Table S1. Satisfactory and unsatisfactory outcomes in ARCP
- Supplementary Table S2. Summary of the scores from psychometric tests, weighted assessment centre, selection centre, and total recruitment scores for public health registrars recruited into specialty training from 2009 to 2012.
- Supplementary Table S3. Association of age, sex, ethnicity, and professional background with the recruitment components and training outcome variables among the cohort of registrars recruited into public health specialty training, 2009-2012.

Supplementary file

Table S1. Satisfactory and unsatisfactory outcomes in ARCP

"Satisfactory" Outcomes	"Unsatisfactory" Outcomes
ARCP Outcome 1 – Achieving progress and development of competences at the expected rate.	ARCP Outcome 2 – Development of specific competences required – additional training time not required.
ARCP Outcome 6 – will be recommended as having completed the training programme and for award of a CCT or CESR/CEGPR.	ARCP Outcome 3 - Inadequate progress - additional training time required.
ARCP Outcome 8 – Out of programme for research, approved clinical training or a career break (OOPR/OOPT/OOPC).	ARCP Outcome 4 - Released from training programme with or without specified competences.
	ARCP Outcome 5 - Incomplete evidence presented - additional training time may be required.
Source: Conference Of Postgraduate Medical Deans (UK). <i>A Reference Guide for Postgraduate Specialty Training in the UK</i> . The Gold Guide. Fifth Edition Version: GG5. MAY2014.	

Table S2. Summary of the scores from psychometric tests, weighted assessment centre, selection centre, and total recruitment scores for public health registrars recruited into specialty training from 2009 to 2012.

Predictor variable	Number of registrars	Mean (Standard deviation)	Median	Range
RANRA	274	56 (7)	56	39-75
WGCT	274	59 (6)	59	41-75
SJT *	123	58(4)	58	48-67
AC score	274	57(6)	57	44-75
SC score	274	58(5)	58	47-71
TR score	274	58(4)	58	48-61

* 2011 onwards

Table S3. Association of age, sex, ethnicity, and professional background with the recruitment components and training outcome variables among the cohort of registrars recruited into public health specialty training, 2009-2012

	Age			Sex		p-value	Ethnicity			Professional background		
	N (%)	N (%)	p-value	N (%)	N (%)		N (%)	N (%)	p-value	N (%)	N (%)	p-value
	≤30 years	≥31 years		Male	Female		White /British	Non-White		Medical	Other	
Predictor variables												
RANRA			0.26			0.09			0.65			0.01
RANRA < 56	57 (45)	75 (52)		30 (41)	102 (52)		108 (49)	19 (53)		39 (39)	93 (55)	
RANRA ≥ 56	69 (55)	69 (48)		44 (59)	94 (48)		114 (51)	17 (47)		61 (61)	77 (45)	
WGCT			0.05			0.01			0.97			0.01
WGCT < 59	50 (40)	74 (51)		24 (32)	100 (51)		104 (47)	17 (47)		35 (35)	89 (52)	
WGCT ≥ 59	76 (60)	70 (49)		50 (68)	96 (49)		118 (53)	19 (53)		65 (65)	81 (48)	
SJT†			0.99			0.16			0.14			0.13
SJT < 58	23 (44)	30 (44)		13 (35)	41 (49)		41 (41)	7 (64)		38 (49)	15 (35)	
SJT ≥ 58	29 (56)	38 (56)		24 (65)	43 (51)		60 (59)	4 (36)		39 (51)	28 (65)	
SC			0.23			0.12			0.88			0.07
SC < 58	56 (44)	74 (51)		41 (55)	88 (45)		104 (47)	18 (50)		89 (52)	41 (41)	
SC ≥ 58	70 (56)	70 (51)		33 (45)	108 (55)		118 (53)	18 (50)		81 (48)	59 (59)	
Outcome variable												
Part A first attempt			0.03			0.33			0.24			0.08
Pass	72 (65)	64 (51)		36 (53)	100 (60)		116 (59)	16 (48)		55 (65)	81 (54)	
Fail	38 (35)	61 (49)		32 (47)	67 (40)		79 (41)	17 (52)		29 (35)	70 (46)	
Part B first attempt			0.18			0.17			<0.01			0.96
Pass	79 (87)	89 (93)		52 (95)	115 (88)		144 (92)	18 (72)		54 (90)	114 (90)	
Fail	12 (13)	7 (7)		3 (5)	16 (12)		12 (8)	7 (28)		6 (10)	13 (10)	
ARCP outcomes			0.05			0.31			0.55			0.77
Satisfactory	84 (90)	94 (80)		49 (80)	128 (86)		151 (85)	21 (81)		12 (16)	20 (15)	
Not satisfactory	9 (10)	23 (10)		12 (20)	21 (14)		26 (15)	5 (19)		62 (84)	116 (85)	

P-value derived from chi-squared test