Evaluating the Wider Impacts of Changes to UK Medical Education in Response to the COVID-19 Pandemic

Technical Annex

This contains supplementary material providing details of methods behind findings reported in the Final Report.

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1 Literature search methods

A lot of research literature has been published since the outbreak of the pandemic. Much of this has been rapid and localised, and as such of lesser quality, but higher quality studies have reached the peer-reviewed literature. We have conducted a rapid review of this evidence, identifying its quantity, quality, and any key findings.

1.1 Review questions

The review addressed three specific questions:

1. What literature has examined the impact of the Covid-19 pandemic on UK postgraduate medical education at the curricula and programme level?
2. What does this report about the impact of Covid-19 on training progression and outcomes?
3. What does this literature report about the experiences/perceptions of stakeholders (including trainees, supervisors, organisational leaders, employers) regarding this impact?

1.2 Search and analysis strategy

On January 17th 2023, we searched peer reviewed and grey literature using Ovid Medline, Ovid Embase and ERIC electronic databases. We also conducted a controlled web search using the search engine DuckDuckGo which does not track activity across sites and so is less likely to skew results. We reviewed the first 20 pages of the returned search in DuckDuckGo, and retrieved all articles from the literature databases.

Working with an information specialist, we developed the search strategy presented in table 1. This was developed for Ovid Medline, and translated to run in Embase and ERIC with the support of a librarian.

Table 1. Search terms for Ovid MEDLINE(R) ALL <1946 to January 17, 2023>

1	COVID-19/ or exp COVID-19 Testing/ or COVID-19 Vaccines/ or SARS-CoV-2/
2	(coronavirus/ or betacoronavirus/ or coronavirus infections/) and (disease outbreaks/ or epidemics/ or pandemics/)
3	(nCoV* or 2019nCoV or 19nCoV or COVID19* or COVID or SARS-COV-2 or SARSCOV-2 or SARS-COV2 or SARSCOV2 or SARS coronavirus 2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona Virus 2).ti,ab,kf,nm,ot,ox,rx,px
4	((new or novel or "19" or "2019" or Wuhan or Hubei or China or Chinese) adj3 (coronavirus* or corona virus* or betacoronavirus* or CoV or HCoV)).ti,ab,kf,ot.
5	(longCOVID* or postCOVID* or postcoronavirus* or postSARS*).ti,ab,kf,ot.
6	((coronavirus* or corona virus* or betacoronavirus*) adj3 (pandemic* or epidemic* or outbreak* or crisis)).ti,ab,kf,ot.
7	((Wuhan or Hubei) adj5 pneumonia).ti,ab,kf,ot.
8	1 or 2 or 3 or 4 or 5 or 6 or 7
9	limit 8 to yr="2019 -Current"
10	exp Education, Medical, Graduate/ed, mt, st, td [Education, Methods, Standards, Trends]
11	((medicine or medical or doctor* or clinician* or physician* or surgeon* or consultant*) adj2 (educat* or course* or training or teach* or graduate* or postgrad* or post grad* or student* or trainee* or intern* or apprentice* or Junior* or Resident* or Residency)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
12	Education, Medical, Continuing/mt, og, st, td [Methods, Organization & Administration, Standards, Trends]
13	((((((((((allergy and immunolog*) or An?esthetics or dermatolog* or diagnostic radiolog* or emergency medic* or family medic* or general practic* or Internal medic* or Acute internal medic* or audiovestibular medic* or audio vestibular medic* or Cardiolog* or endocrinolog* or Gastroenterolog* or geriatric medic* or Genitourinary medic* or genito urinary medic* or Haematology* or medical oncolog* or metabolic medic* or palliative medic* or Medical genetic* or neurolog* or nuclear medic*OR obstetrics) and gyn?ecolog*) or opthalmolog* or Pathology* or P?ediatric* or physical medicine) and rehabilition) or rehabilitation medic* or renal medic* or nephrolog* or respiratory medic* or rheumatolog* or sports) and exercise medic*) or preventive medic* or Psychiatr* or learning disabilit* or medical psychotherapy or intensive care medic* or Histopatholog* or histo patholog* or diagnostic neuropatholog* or radiation oncolog* or Surge* or public health or Urolog* or vascular Surgery* or neurosurge* or plastic surge* or trauma) and orthop?edic surge*) or p?ediatric surge* or Otolaryngolog* or core surge* or general surge* or oral) and maxillofacial surge*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
14	"psychiatry and psychology (non mesh)"/ or medicine/ or addiction medicine/ or adolescent medicine/ or "allergy and immunology"/ or anesthesiology/ or bariatric medicine/ or behavioral medicine/ or clinical medicine/ or community medicine/ or dermatology/ or emergency medicine/ or forensic medicine/ or general practice/ or genetics, medical/ or geriatrics/ or global health/ or hospital medicine/ or integrative medicine/ or internal medicine/ or military medicine/ or molecular medicine/ or naval medicine/ or neurology/ or osteopathic medicine/ or palliative medicine/ or pathology/ or pediatrics/ or perioperative medicine/ or "physical and rehabilitation medicine"/ or psychiatry/ or public health/ or radiology/ or regenerative medicine/ or reproductive medicine/ or social medicine/ or specialties, surgical/ or colorectal surgery/ or general surgery/ or gynecology/ or neurosurgery/ or obstetrics/ or ophthalmology/ or orthognathic surgery/ or orthopedics/ or otolaryngology/ or surgery, plastic/ or surgical oncology/ or thoracic surgery/ or traumatology/ or urology/ or sports medicine/ or optometry/ or psychology, medical/
15	13 or 14
16	10 or 11 or 12 or 15
17	Curriculum/ed, mt, st, td [Education, Methods, Standards, Trends]
18	((curricul* or syllab* or program* or study or studies or timetable* or time table* or schedule* or module* or subject* or trend* or assessment* or assessing or assess or assessed or framework* or frame work* or structure* or strateg*) adj2 (change* or adjust* or adapt* or derogation* or new)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
19	17 or 18
20	9 and 16 and 19

All retrieved titles and abstracts were screened by two independent reviewers (either MB and BB, or MB and GF), with disagreements resolved by a third reviewer (either BB or GF). Inclusion and exclusion criteria are detailed in table 2.

Table 2. Inclusion and exclusion criteria for screening

	Inclusion criteria	Exclusion criteria
Intervention:	All material focussing on changes, adaptations, or innovations during Covid-19 at a curricula or programme level.	Material focussed on changes made at a grass-roots level (e.g., to the delivery of a teaching session)
Setting:	Studies of postgraduate medical education in the UK.	Studies relating to the undergraduate medical education setting within the UK, or any setting outside the UK.
Participants:	Doctors at any stage of postgraduate training, within any specialty; their supervisors in any capacity, employers, and educational organisations (HEE, NES etc.).	International literature focussed on Covid-19 derogations outside of a UK context.
Study design:	All study designs. Empirical studies. White papers, grey literature not published in a peer-reviewed and indexed journal (e.g., conference papers, abstracts, and posters).	Commentaries, letters, books, book chapters
Language:	Published in the English language	Non-English language papers
		Those without full text following contact of the corresponding author

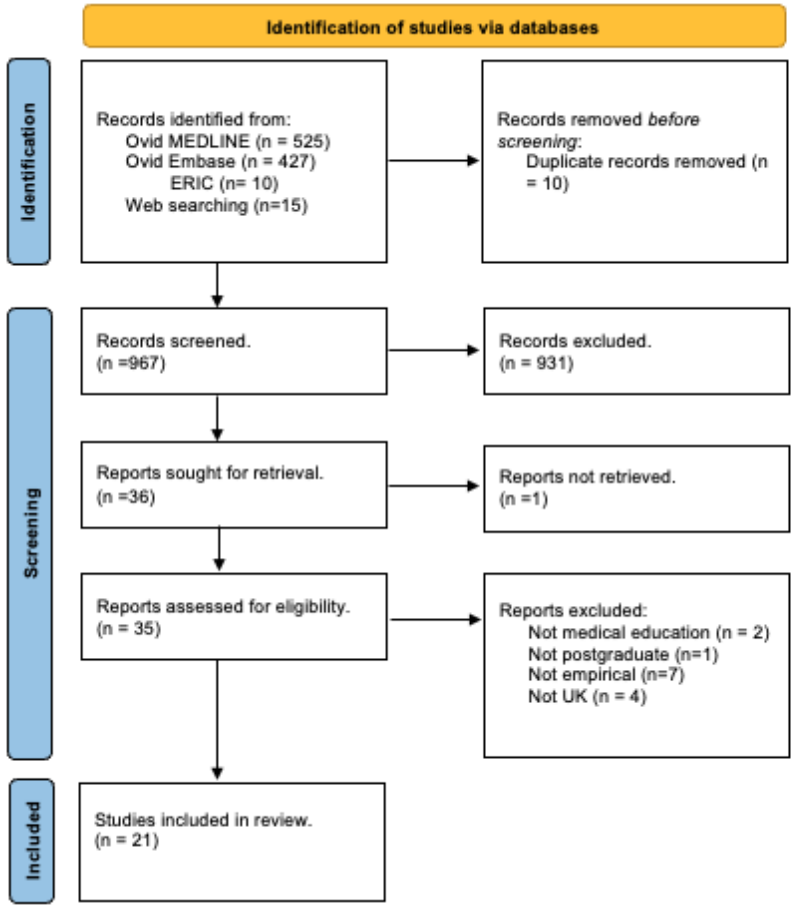
Full text of remaining papers was then reviewed by MB. We created, through group discussions, a data extraction form of relevant content to answer our review questions. Studies included in the review were analysed in-depth, and data extracted (by MB) regarding study title, authors, year of publication, journal, study design, participant characteristics, descriptions of curricula and associated derogations, the impact of derogations on outcomes, the impact of derogations on experiences, benefits, challenges, and directions for future research. Final charted data were discussed and agreed as a group. Study quality was not assessed, in line with established rapid review methodology.

We performed a qualitative thematic analysis on all data, coding extracted data inductively and descriptively, and then synthesising codes into overarching themes to tell the story of the collated data. We also conducted basic numerical counts of contextual information (year published, population studied, stage of training, and study type). This quantitative data adds context to our qualitative findings.

1.3 Search results

Across all search sites, we retrieved 967 records for screening. 931 of these records were excluded on title and abstract screening. This is representative of the expansiveness of our search. The text of one record could not be accessed, even with attempted contact with the corresponding author. The full texts of 35 papers were assessed for eligibility, and 21 were deemed eligible for inclusion in the review. This process, with numerical counts for each stage, is detailed in Figure 1, as a PRISMA diagram.

Figure 1. PRISMA diagram detailing the process of study identification, screening, and inclusion



Included papers

The studies retained in the final review are listed in table 3. Of the final 21 articles, 5 were published in 2020, 9 in 2021, and 7 in 2022. The peak in 2021 represents the publication of research conducted during the first wave of Covid, with some 2022 articles representing initial data (n=4) and slightly fewer representing studies conducted at later points during the pandemic (n =3). A range of specialities are represented in included studies (gastroenterology, anaesthetics, radiology, paediatrics, orthopaedics, cardiothoracic surgery, oral surgery, plastic surgery, obstetrics and gynaecology, and public health), as well as perspectives from the foundation programme, and studies that report across a range of surgical, or surgical and medical, specialities.

The studies skew towards perspectives from surgical and craft specialities (n= 12). As per our inclusion criteria, all studies are empirical. There is a high proportion of cross-sectional mixed-methods surveys (n=17), with two studies collecting quantitative data from portfolios and ARCP, only one interview study, and one focus group study.

Table 3. Papers included in final review

Raju SA, Harris R, Cook C, et al. 2022. UK-wide study of the opinions of gastroenterology trainees: COVID19, shape of training and the future workforce. *Frontline Gastroenterology*, *13*(5), pp386-391
Subramaniam J, Durrant F, Edwardson S, et al. 2022. Recruitment to higher specialty training in anaesthesia in the UK during the COVID19 pandemic: a national survey *Anaesthesia*, *77*(5), pp538-546
Chua EP, Tan Y, Mercer LK, Wig S. 2022. OA03 Impact of the COVID19 pandemic on rheumatology training: results of the regional survey from the North West of England. *Rheumatology*, *61*(Supplement_1), ppkeac132-002
Veerasuri S, Vekeria M, Davies SE, et al. 2020. Impact of COVID19 on UK radiology training: a questionnaire study *Clinical radiology*, *75*(11), pp877-e7
Fossey S, Ather S, Davies S, et al. 2021. Impact of COVID19 on radiology training: royal college of radiologists junior radiologists forum national survey. *Clinical Radiology*, *76*(7), pp549-e9
Harmer MJ, Southgate G, Raja M, Alam S, 2022 Paediatric trainees' training experiences during the COVID19 pandemic: a national survey *Archives of Disease in Childhood-Education and Practice*, *107*(1), pp64-70
Jayatilaka MLT, As-Sultany M, Gabr A, et al. 2021. Collaborative Overview of coronaVIrus impact on ORTHopaedic training in the UK (COVI-ORTH UK) *the surgeon*, *19*(6), ppe331-e337
Prince S, Adhiyaman V. 2021. What was the impact of COVID19 on the foundation training programme in north Wales? *Future Healthcare Journal*, *8*(1), pe5
Bodansky D, Thornton L, Sargazi N, et al. 2021 Impact of COVID19 on UK orthopaedic training *The Bulletin of the Royal College of Surgeons of England*, *103*(1), pp38-42
Sasitharan A. 2020. COVID19: The impacts on foundation training in district general hospitals in the East of England and the East Midlands *Clinical Medicine*, *20*(6), pe253
Caruana EJ, Patel A, Kendall S, Rathinam S. 2020. Impact of coronavirus 2019 (COVID19) on training and well-being in subspecialty surgery: a national survey of cardiothoracic trainees in the United Kingdom. *The Journal of Thoracic and Cardiovascular Surgery*, *160*(4), pp980-987
Gonzi G, Gwyn R, Rooney K, et al. 2020 The role of orthopaedic trainees during the COVID19 pandemic and impact on post-graduate orthopaedic education: a four-nation survey of over 100 orthopaedic trainees *Bone & joint open*, *1*(11), pp676-682
Clements JM, Burke J, Nally D, et al. 2021. COVID19 impact on Surgical Training and Recovery Planning (COVID19-STAR)-A cross-sectional observational study *International Journal of Surgery*, *88*, p105903
Clements JM, Burke JR, Hope C, et al. 2021 The quantitative impact of COVID19 on surgical training in the United Kingdom *BJS open*, *5*(3), pzrab051
Aulakh G, Wanis C, Wilson G, Moore R. 2021. The impact of COVID19-19 on oral surgery training. *Oral Surgery*, *14*(4):313-320
Ibrahim N, Rich H, Ali S, Whitake, IS. 2021. The effect of COVID19 on higher plastic surgery training in the UK: A national survey of impact and damage. limitation *Journal of Plastic, Reconstructive & Aesthetic Surgery*, *74*(7), pp1633-1701
Elghobashy M, Stout A, Hatti A, et al. 2022. The effect of the measures taken during the coronavirus pandemic on specialty trainees in obstetrics and gynaecology in the United Kingdom: an online questionnaire survey in one region. *Journal of Obstetrics and Gynaecology,* 42(5):1455-1460
Duggan I, Hablase R, Beard L, et al. 2022. The impact of COVID19 on O&G trainees; where are we now? *Facts, Views & Vision in ObGyn*, *14*(1):69
Payne A, Rahman R, Bullingham R, et al. 2021. Redeployment of surgical trainees to intensive care during the COVID19 pandemic: evaluation of the impact on training and wellbeing *Journal of surgical education*, *78*(3), pp813-819
Hall L, Bisset K, Lynch L, et al. 2022. Training during the COVID19 pandemic: the experience of public health registrars in the London and Kent, Surrey, Sussex training programme *Journal of Public Health*, pfdac130
Slater T, Round J. 2022. Shielding during medical training: an exploration of effects, consequences and best practices. *Future Healthc J*

Details of the analysis and findings from these studies is included in the main final report.

2 Statistical analysis of secondary data

This summarises the data analysis undertaken on secondary data provided by the GMC, and provides full results behind the key points summarised in the main report. Analysis addressed two questions:

1. Is there any evidence that ARCP and exam outcomes were affected by the introduction of derogations in 2020.
2. Were differences between demographic groups affected by the introduction of the derogations.

2.1 Method

While simple frequencies or proportions of outcomes can provide some indication of change over time, the effects of time can be distorted by the presence of confounding variables. For example, if the demographic composition of trainees in one year is different from another, underlying demographic effects could be interpreted as indicating a change over time when none is present. For this reason, binary logistic regression was carried out – the output of which indicates the difference in **relative** likelihood of a binary outcome (for example pass or fail) in the presence of a given variable when compared to a reference group, controlling for all other predictor variables.

2.1.1 Treatment of data

To clarify analyses and aid interpretation of results, some demographic variables were simplified. Ethnic group was dichotomised to 'White' and 'Other', and place of primary medical qualification was dichotomised to 'UK' and 'non-UK'. Geographical location was simplified from Deanery to UK nation – England, Wales, Scotland, Northern Ireland.

ARCP outcomes which do not reflect a trainee's performance in training were excluded: outcome 5 (an essentially administrative placeholder outcome where insufficient evidence provided) and outcome 8 (the trainee is out of programme). Advice in 2020 was that outcome 5 should be avoided where possible to reduce the burden on trainees and assessors. Two instances of outcome 9, a requirement for 'top up' training after completion of a training programme, were also removed from 2018 data. Data for Foundation Programme trainees are not reported here – there were restrictions on the availability of COVID-19 outcomes, and there was no effect of year on successful outcome, indicating COVID-19 did not affect outcomes or progression for these trainees.

For ARCP analysis specialty training programmes were collapsed into groups as indicated in table 4 (this maximised data availability by reducing the exclusion of categories with 3 or fewer members, required for data protection). Some duplicate rows were identified, and excluded, perhaps due to this simplification: doctors undertaking dual training, and so having more than one ARCP, would appear as duplicates if those specialties were in the same group. Occupational medicine and broad-based training were excluded due to having very few trainees (<10) in some years.

Table 4. Specialty groups and simplified specialties

ACCS	Acute Care Common Stem; ACCS - Acute Medicine; ACCS - Anaesthesia; ACCS - Emergency Medicine; ACCS - Unthemed
Anaesthetics	Core Anaesthetics Training; Intensive Care Medicine; Anaesthetics; Pre-hospital Emergency Medicine
Medicine	Acute Internal Medicine; Allergy; Audio Vestibular Medicine; Aviation And Space Medicine; Cardiology; Clinical Genetics; Clinical Neurophysiology; Clinical Pharmacology And Therapeutics; Combined Infection Training; Core Medical Training; Dermatology; Endocrinology And Diabetes Mellitus; Genito-urinary Medicine; Geriatric Medicine; Haematology; Hepatology; Immunology; Internal Medicine Training Stage One; Infectious Diseases; Medical Oncology; Medical Ophthalmology; Tropical Medicine; Neurology; Nuclear Medicine; Palliative Medicine; Pharmaceutical Medicine; Paediatric Cardiology; Rehabilitation Medicine; Renal Medicine; Respiratory Medicine; Rheumatology; Sport And Exercise Medicine; Stroke Medicine; General (internal) Medicine; Gastroenterology
Surgery	Cardio-thoracic Surgery; Core Surgical Training; Neurosurgery; Oral And Maxillo-facial Surgery; Otolaryngology; Trauma And Orthopaedic Surgery; Urology; Vascular Surgery; Plastic Surgery; Paediatric Surgery; General Surgery
Pathology	Chemical Pathology; Diagnostic Neuropathology; Metabolic Medicine; Medical Microbiology; Medical Microbiology And Virology; Paediatric Pathology; Medical Virology; Histopathology; Paediatric And Perinatal Pathology; Forensic Histopathology
Psychiatry	Child And Adolescent Psychiatry; Core Psychiatry Training; Liaison Psychiatry; Forensic Psychiatry; Psychiatry Of Learning Disability; Substance Misuse Psychiatry; Rehabilitation Psychiatry; Old Age Psychiatry; Medical Psychotherapy; General Psychiatry
Paediatrics	Child Mental Health; Community Child Health; Paediatric Clinical Pharmacology And Therapeutics; Paediatric Diabetes And Endocrinology; Paediatric Emergency Medicine; Paediatric Gastroenterology, Hepatology And Nutrition; Paediatric Allergy Immunology and Infectious Diseases; Paediatric Inherited Metabolic Medicine; Paediatric Intensive Care Medicine; Paediatric Nephrology; Paediatric Neurodisability; Paediatric Neurology; Paediatric Oncology; Paediatric Palliative Medicine; Neonatal Medicine; Paediatric Respiratory Medicine; Paediatric Rheumatology; Paediatrics
Obstetrics and Gynaecology	Community Sexual And Reproductive Health; Maternal And Fetal Medicine; Gynaecological Oncology; Urogynaecology; Reproductive Medicine; Obstetrics And Gynaecology
Radiology	Clinical Oncology; Clinical Radiology; Interventional Radiology
Emergency Medicine	Emergency Medicine
General Practice	General Practice
Occupational Medicine	Occupational Medicine
Ophthalmology	Ophthalmology
Public Health Medicine	Public Health Medicine
Broad Based Training	Broad Based Training

For exam data, only exam results of those in recognised training programmes were included, although whether a trainee was in a 'relevant training programme' was not a criterion for inclusion. This meant for example that Foundation Programme trainees taking MRCP(UK) Part 1 exams, for which Foundation Programme is 'not relevant', were included, as were others taking exams outside of their specialty training programme. Data on trainees' less than full time working was not available through the national training survey in 2020 as it was in other years. This field was instead populated from ARCP data for 2020.

No imputation of missing data was undertaken.

2.1.2 Analysis

ARCP and exam data were analysed using mixed effects logistic regression models undertaken in R v4.3.1[1] using the lmer package for mixed effects modelling.[2] Effects are described using odds ratios (from the jtools package in R[3]) and predicted probabilities (from the ggeffects package[4]).

The aim of analysis was to identify any changes in outcomes with year, particularly in 2020 with the introduction of derogations, and subsequently. It was important to control for variables known to be associated with outcomes, in case the demographic constitution of cohorts varied. Interaction effects were also considered, to identify whether any changes with year were consistent across demographic groups.

For all models, fixed effect predictors were calendar year, gender, ethnic group (dichotomised to 'white' and 'other'), place of primary medical qualification (dichotomised to 'UK' and 'non-UK'), working pattern (less than full time or full time), and nation of the UK. Individual doctor was included as a random effect with random intercept, meaning that variability of individual doctors was controlled for. For ARCP data, specialty group was also included as a fixed effect, to identify whether the likelihood of different outcomes varied between specialty groups.

For exam data, the specific exam taken was included as a random effect with random intercept, to reflect the variability of exam difficulty. Exam modality was also included as a fixed effect. This distinguished between 'written' knowledge-based exams (including multiple choice and short answer questions), which could be relatively easily moved online during the pandemic, and clinical, practical and oral exams involving practical skills or multiple stations, which required greater adaptations. Table 5 summarises this categorisation. The FRCEM Quality Improvement Project component was not included in analysis as it did not fit either definition of an exam.

Table 5. Categorisation of exams as 'written' or 'other'

Written exams		Other exams (clinical, practical, oral)
Diploma in Pharmaceutical Medicine: Part 1	MFOM Part 1	DOHNS OSCE
Diploma in Pharmaceutical Medicine: Part 2	MRCEM Primary	FFICM OSCE
FFICM MCQ	MRCEM SBA	FFICM OSCE & SOE
FICM MCQ	MRCGP AKT	FFICM SOE
FPH Part A	MRCOG Part 1	FRCA Final SOE
FPH Part B	MRCOG Part 2	FRCA Primary OSCE
FRCA Final Written	MRCP Part 1	FRCA Primary OSCE SOE
FRCA Primary MCQ	MRCP Part 2	FRCA Primary SOE
FRCEM Crit App	MRCPCH Applied Knowledge in Practice (AKP)	FRCEM OSCE
FRCEM FINAL SAQ		FRCOphth Part 2 Oral
FRCEM INT SAQ	MRCPCH Foundation of Practice (FOP)	FRCPath Part 2 Practical and Oral Clinical Biochemistry (module 1)
FRCEM SBA	MRCPCH Theory and Science (TAS)	
FRCEM SJP	MRCS - Part A - MCQ	FRCPath Part 2 Practical and Oral Paediatric Pathology
FRCOphth Part 1	SCE Acute Medicine	
FRCOphth Part 2 Written	SCE Dermatology	FRCPath Part 2 Practical Haematology
FRCPath Part 1 Haematology	SCE Endocrinology and Diabetes	FRCPath Part 2 Practical Histopathology
FRCPath Part 1 Histopathology	SCE ESEGH	FRCS Part 2 Cardiothoracic Surgery
FRCPath Part 1 Infection and Combined Infection Certificate Examination (CICE)	SCE ESENeph	FRCS Part 2 General Surgery
	SCE Geriatric Medicine	FRCS Part 2 Neurosurgery
FRCS Part 1 Cardiothoracic Surgery	SCE Medical Oncology	FRCS Part 2 Oral & Maxillofacial Surgery
FRCS Part 1 General Surgery	SCE Nephrology	FRCS Part 2 Otolaryngology
FRCS Part 1 Neurosurgery	SCE Neurology	FRCS Part 2 Paediatric Surgery
FRCS Part 1 Oral & Maxillofacial Surgery	SCE Palliative Medicine	FRCS Part 2 Plastic Surgery
FRCS Part 1 Otolaryngology	SCE Pan European Gastro (ESEGH)	FRCS Part 2 Trauma & Orthopaedic Surgery
FRCS Part 1 Paediatric Surgery	SCE Respiratory Medicine	
FRCS Part 1 Plastic Surgery	SCE Rheumatology	FRCS Part 2 Urology
FRCS Part 1 Trauma & Orthopaedic Surgery		FRCS Part 2 Vascular Surgery
FRCS Part 1 Urology		MRCEM OSCE
FRCS Part 1 Vascular Surgery		MRCGP CSA
		MRCGP RCA
		MRCOG Part 3
		MRCP Paces
		MRCPCH Clinical
		MRCS - Part B - OSCE
		RCOphth Refraction Certificate

For ARCP data, three analyses considered dichotomised outcome variables:

- successful outcomes (outcomes 1, 7.1 or 6) compared to all other ARCP outcomes,

- developmental outcomes (outcomes 2, 3, 7.2 or 7.3) compared to all others, and
- covid outcomes (outcomes 10.1 or 10.2) compared to all others.

For exam data, the regression outcome was simply pass/fail. Only the first sitting of an exam by a trainee was included (this was derived from the dates of different sittings).

Maximal models including interaction terms between year and other predictors were constructed, and terms removed which did not contributed to model fit as indicated by the Akaike information criterion (AIC) using the drop1 function in lmer.

2.2 Results

All analyses identified significant effects, and interactions between predictors. ARCP outcomes varied with year, but with some variation in the magnitude of variation with demographic variables. Results from different analysis are grouped below by the different outcome variables, to illustrate where these effects are similar.

Interaction effects are illustrated by plots of predicted probabilities – these indicate the likelihood of an outcome as predicted by the regression model, controlling for those factors not represented in the plot. These probabilities may differ from the percentages of the sample receiving an outcome as they are averaged across levels of covariates.

Full summary tables including odds ratios and confidence intervals for each effect are included at the end of this annex.

2.2.1 Effects on ARCP outcomes

Effect of year

All analyses of ARCP outcomes indicate a change over time, with an overall decrease in the likelihood of gaining a successful outcome in 2020, remaining low in 2021, and recovering in 2022. Table 6 gives the odds ratios for this effect, with other years compared to 2020. An odds ratio (OR) less than 1 indicates an outcome is less likely than for the reference group, and an OR more than 1 indicates an outcome is more likely. Table 6 therefore indicates that overall successful outcomes were 4 times more likely in 2019 than 2020, and in 2021 over twice as likely than in 2020, increasing to 2.8 times as likely in 2022.

Table 6. Odds ratios for successful outcome compared to 2020

Year	OR	95% CI lower limit	95% CI upper limit	z-value	p-value
2017	2.99	2.66	3.35	18.50	0.000
2018	3.49	3.11	3.92	20.92	0.000
2019	4.06	3.61	4.56	23.42	0.000
2021	2.06	1.86	2.29	13.97	0.000
2022	2.80	2.52	3.11	19.13	0.000

Odds ratios of gaining outcomes 1, 6 or 7.1 compared to outcomes 2, 3, 4, 7.2, 7.3, 10.1 or 10.2.

Table 7 illustrates the odds ratios of COVID-19 outcomes in 2021 and 2022 compared to 2020, indicating a rapid decline in the use of outcomes 10.1 and 10.2, to just one fifth the likelihood of their use in 2022, compared to 2020.

Table 7. Odds ratios for developmental outcome compared to 2020

Year	OR	95% CI lower limit	95% CI upper limit	z-value	p-value
2021	0.61	0.61	0.56	0.67	-10.93
2022	0.21	0.21	0.19	0.23	-26.52

Odds ratios of gaining outcomes 10.1 or 10.2 compared to outcomes 1, 2, 3, 4, 7.1, 7.2 or 7.3.

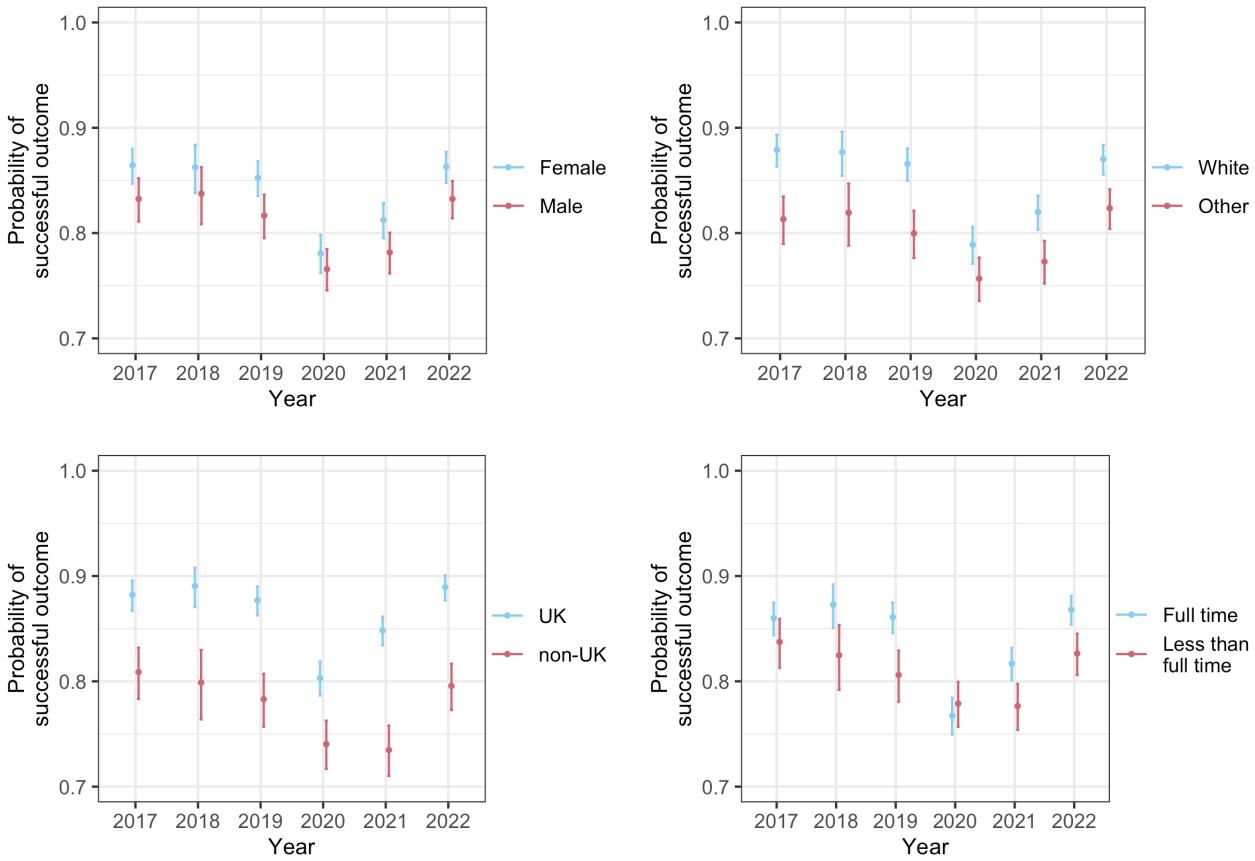
Interaction effects indicate that not only did the probability of getting a given outcome vary with year, but also with the gender and ethnicity of the individual trainee, whether they worked less than full-time, and of their place of qualification, their training programme and their location in the UK.

The following sections illustrate these patterns as indicated by the predicted probabilities derived from regression models. Figures illustrate both significant interactions, showing some convergence or divergence between levels of the predictor variable, and non-significant effects for comparison. Some interactions are statistically significant, but with relatively small variations in the probability of the outcome variable. Discussion is limited to those where effects are clear.

Effects on successful outcomes

Figure 2 illustrates the effects of gender, ethnicity, less than full time working, and place of primary medical qualification on the probability of getting a successful outcome (ie 1, 7.1 or 6). These illustrate the underlying decrease in the incidence of successful outcomes in 2020, but also a narrowing of gaps which were apparent in previous years – women being more likely than men, white trainees more likely than other ethnic groups, full time more likely than others, and UK graduates more likely than non-UK graduates to gain a successful outcome. The closing of the gaps for gender, ethnicity and LTFT working is particularly notable. However, the prior differences also seem to reassert themselves by 2022, as the overall probability approaches pre-pandemic levels. Non-UK graduates, and less than full-time trainees, appear to recover less quickly than UK-qualified and full-time trainees, remaining at a lower probability of success into 2021.

Figure 2. Interaction plots for ARCP successful outcomes over time

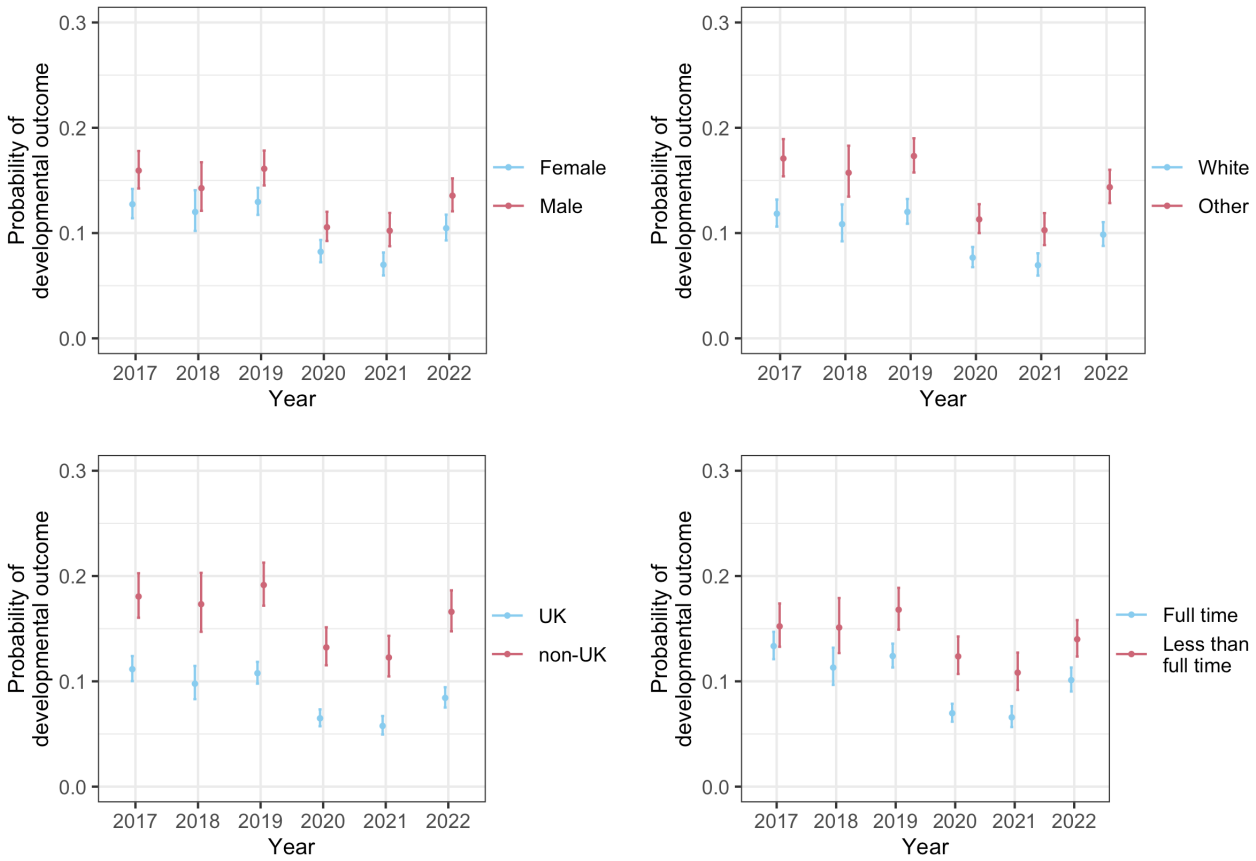


Plots show predicted probabilities and 95% confidence intervals.

Effects on developmental outcomes

The pattern in figure 3 is similar to that in figure 2, illustrating the likelihood of getting a developmental outcome (outcomes 2, 3, 7.2 or 7.3). The probability of these outcomes also dropped in 2020, before rising again in 2021 and 2022. The difference between ethnic groups remained constant – the interaction effect was not statistically significant, despite some apparent convergence in 2020. The interaction effects for gender, place of PMQ and working hours were significant, although any convergence and divergence is less pronounced than for successful outcomes.

Figure 3. Interaction plots for ARCP developmental outcomes over time



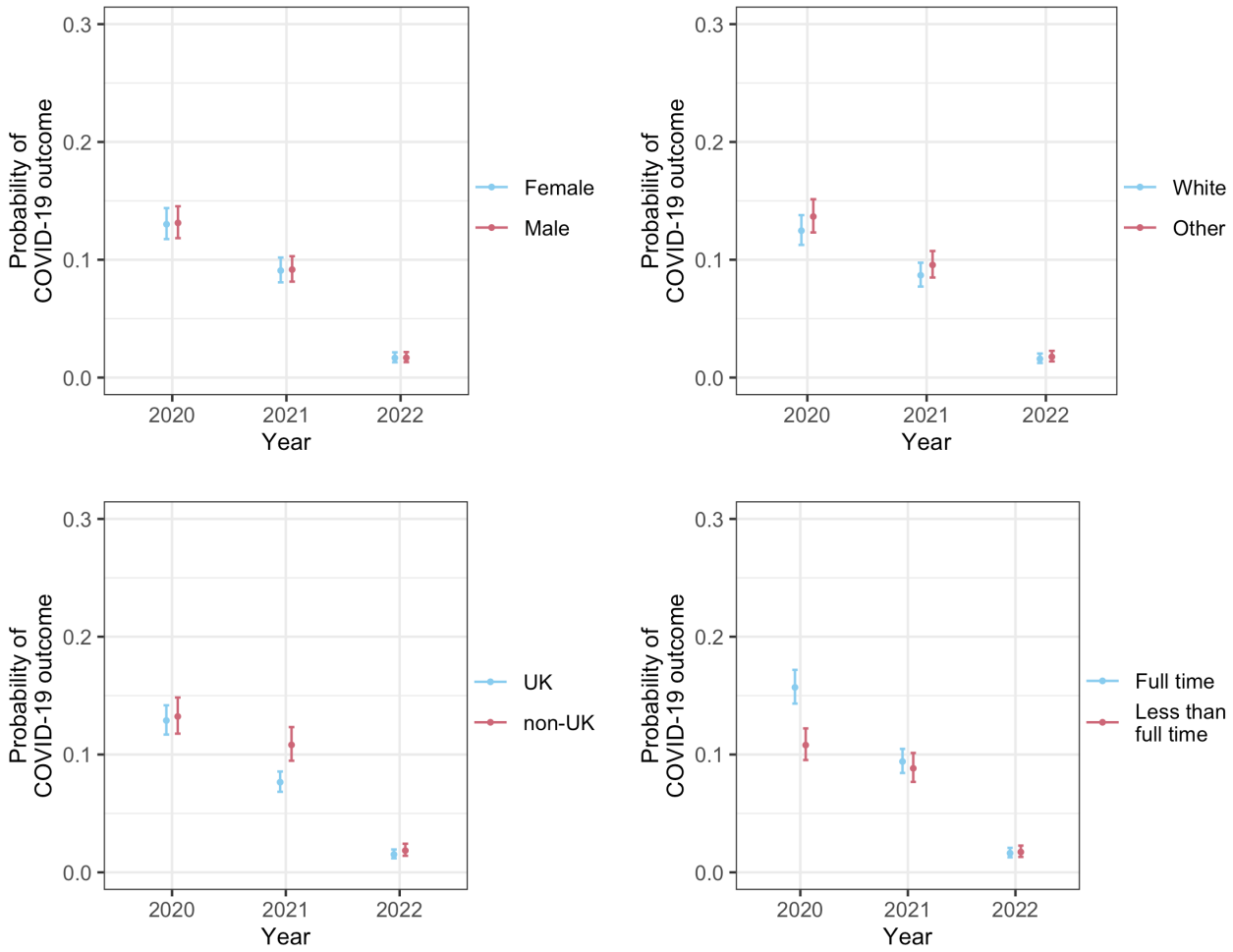
Plots show predicted probabilities and 95% confidence intervals.

Effects on COVID-19 outcomes

Plots of predicted probability of gaining outcomes 10.1 or 10.2 are presented in figure 4. The rapid decrease in the usage of these outcomes was apparent for all groups, but here there is no effect of gender, meaning male and female trainees were equally likely to get one of these outcomes, and the interaction between year and ethnicity was again non-significant, meaning the difference between white and other trainees remained constant over time.

Interactions for LTFT and place of PMQ were significant, and indicate that in 2020, full time trainees were more likely to get a COVID-19 outcome, but not in other years, and that in 2021, non-UK graduates were more likely to get a COVID-19 outcome.

Figure 4. Interaction plots for COVID-19 outcomes over time

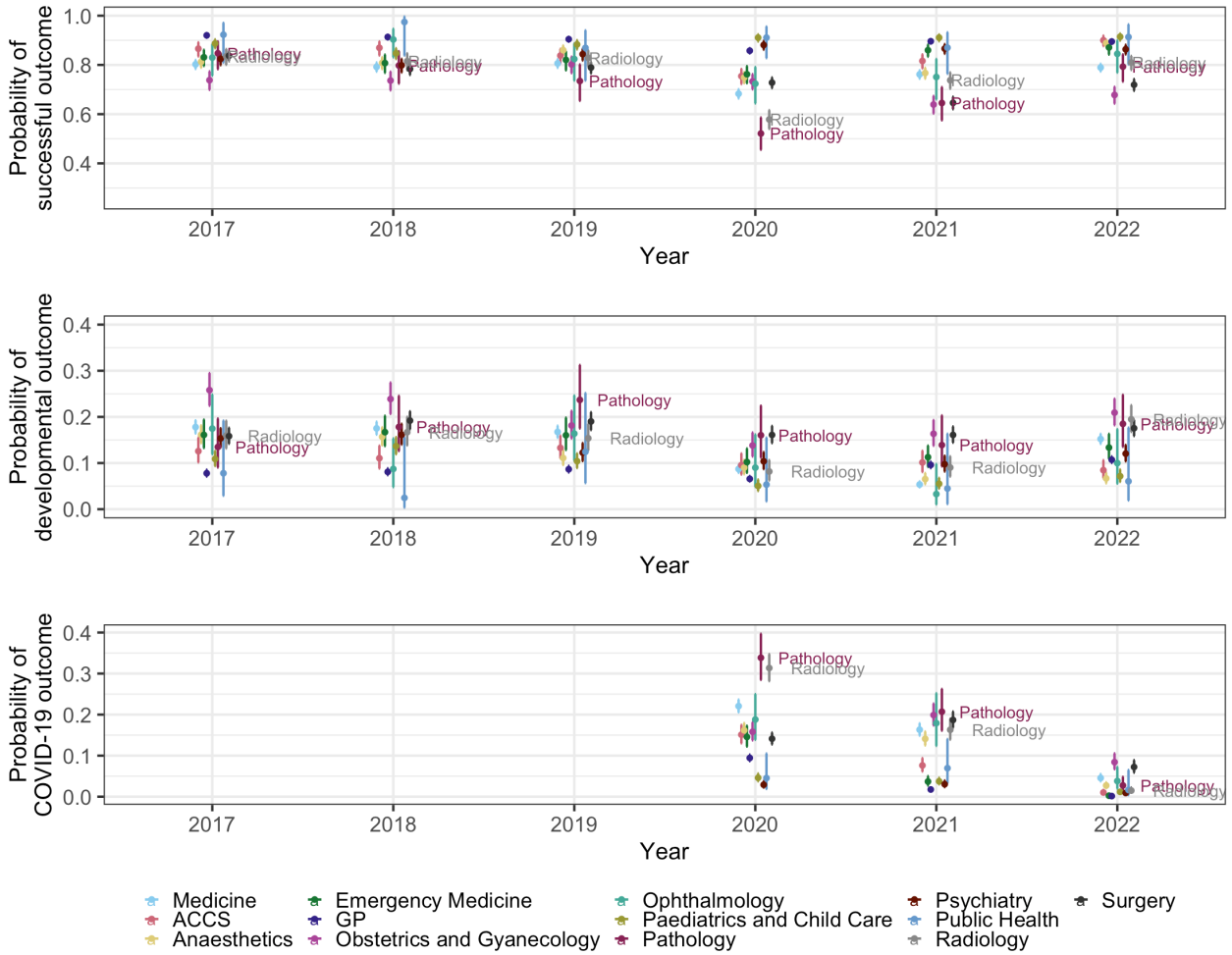


Plots show predicted probabilities and 95% confidence intervals.

Effect of specialty group

Clinical specialty groups were included in ARCP analysis. Analysis showed variability of the probability of different outcomes, again controlling for other variables, and again showing variation over time (figure 5). Points for pathology and radiology are labelled to highlight the most notable effect here. These specialties are clearly separate from other specialty groups in 2020 only, with lower probabilities of a successful outcome, and higher probability of an outcome 10.1 or 10.2. In 2021 and 2022 this separation of outcomes appears to disappear.

Figure 5. Probability of successful, developmental and COVID-19 outcomes over time by specialty group

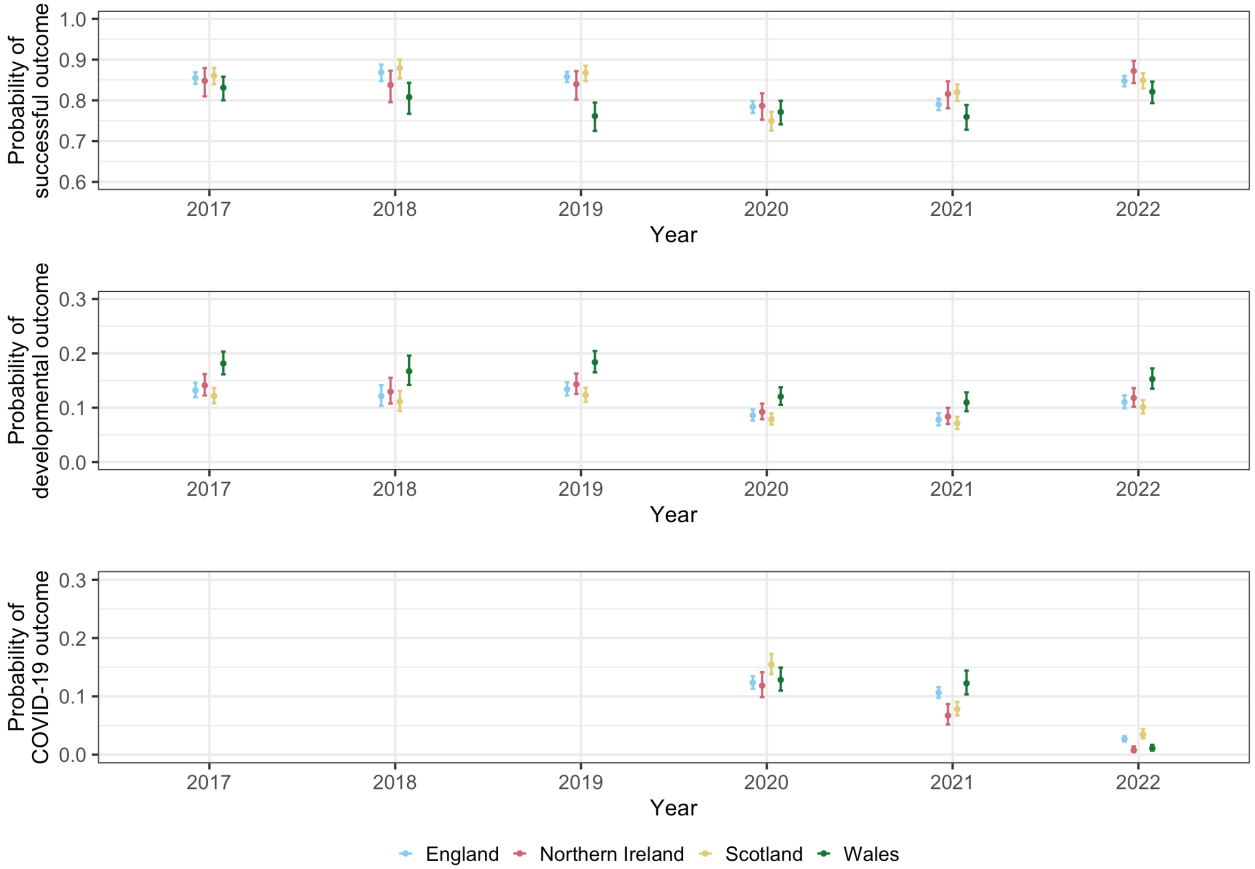


Plots show predicted probabilities and 95% confidence intervals.

Effect of geography

Finally, ARCP analysis identified different outcomes associated with nation of the UK. Plots here (figure 6) suggest a significant interaction stems from trainees in Wales being less likely to receive a successful outcome and more likely to receive a developmental outcome in 2019, before the pandemic. However, COVID-19 outcomes did vary slightly between nations, in 2021 particularly.

Figure 6. Probability of ARCP outcomes over time by UK nation



Plots show predicted probabilities and 95% confidence intervals.

Outcomes gained following a COVID-19 outcome

The analyses above combine outcomes 10.1 and 10.2, accounting for the different availability of each at different stages of training, in different specialties. However, outcome 10.2 had greater potential impact on trainees as it led to additional training time, and so potential delay in progression through training grades to CCT.

To consider this, the subsequent outcomes of doctors who received a 10.2 were examined. While the specific order of outcomes was not available, it can be inferred that outcomes 1, 6 and 4 follow an outcome 10.2, as they are terminal outcomes for a given stage of training.

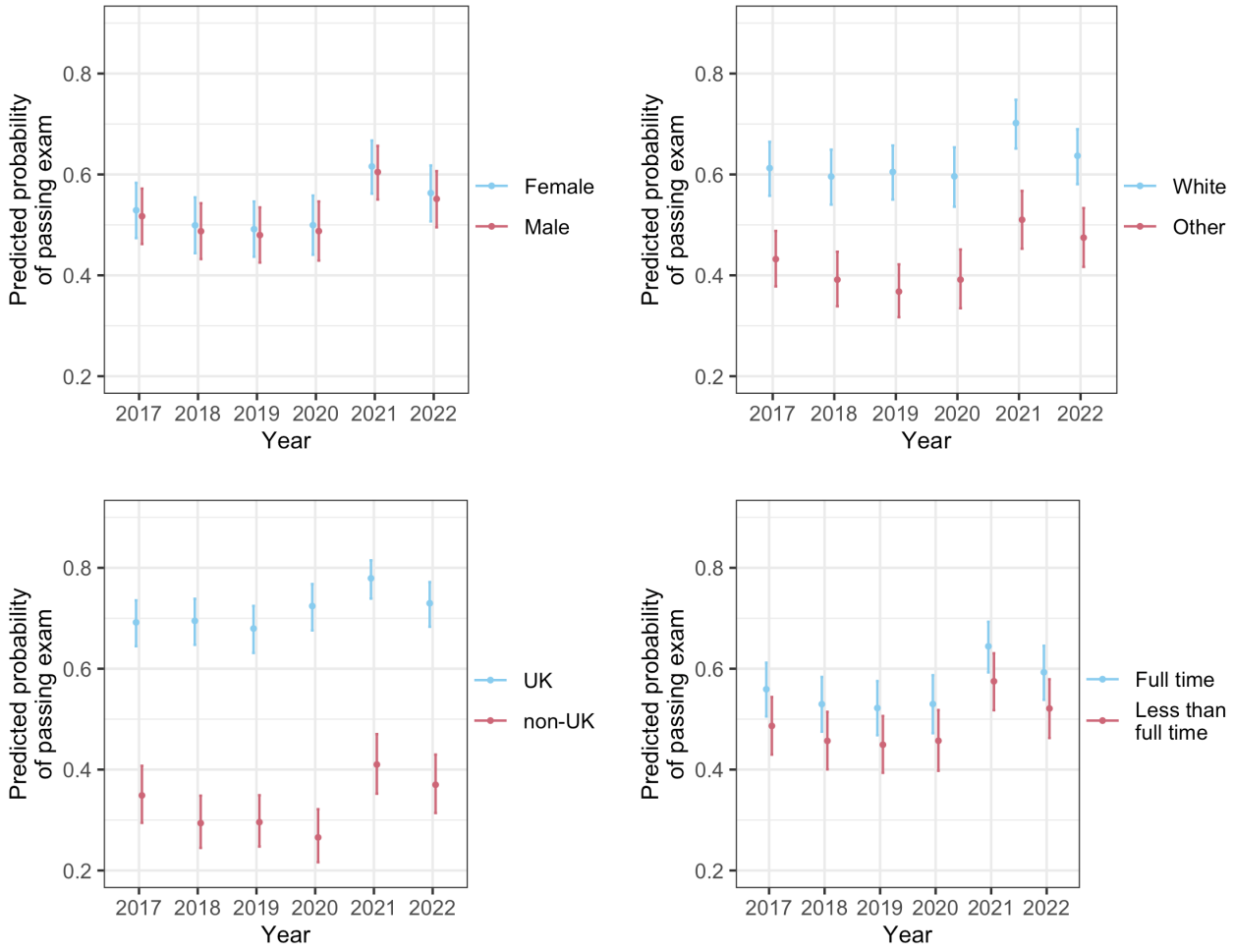
A total of 2155 outcome 10.2s were received by 2092 trainees in 2020 and 2021. Of these outcomes, 1086 were linked to just one other outcome in the same stage of training, and 80% of these were successful (65% outcome 6, 15% outcome 1), while 1% exited the programme with outcome 4. The remainder of the other outcomes received were developmental outcomes in the same stage of training (9%, outcome 3; 5%, outcome 2; 5%, outcome 10.1), but it is possible that these were awarded before the 10.2.

Another 2% had received a second 10.2. This may be indicative of training in two specialties, for example, some have outcomes for 'medicine' and 'pathology', but this detail is not available for all trainees. There were also 379 outcome 10.2s associated with more than one other outcome in the same stage of training. These may also be confounded by dual training, but of these subsequent outcomes, 310 (82%) included a 1 or a 6.

2.2.2 Effects on exam results

Figure 7 illustrates changes in predicted probability of passing exams in each year. Most notable is that trends from 2017-2019 continue into 2020, with a step-change in 2021 to a higher likelihood of passing. The interactions between year and gender, and between year and LTFT are not significant, and nor is the effect of gender. The interaction between year and ethnicity is significant, but changes in the underlying difference between white and other ethnic groups are marginal. The interaction between year and PMQ location is significant, and appears to be a consequence of divergence between UK and non-UK graduates between 2017 and 2020, followed by some convergence in 2021 and 2022.

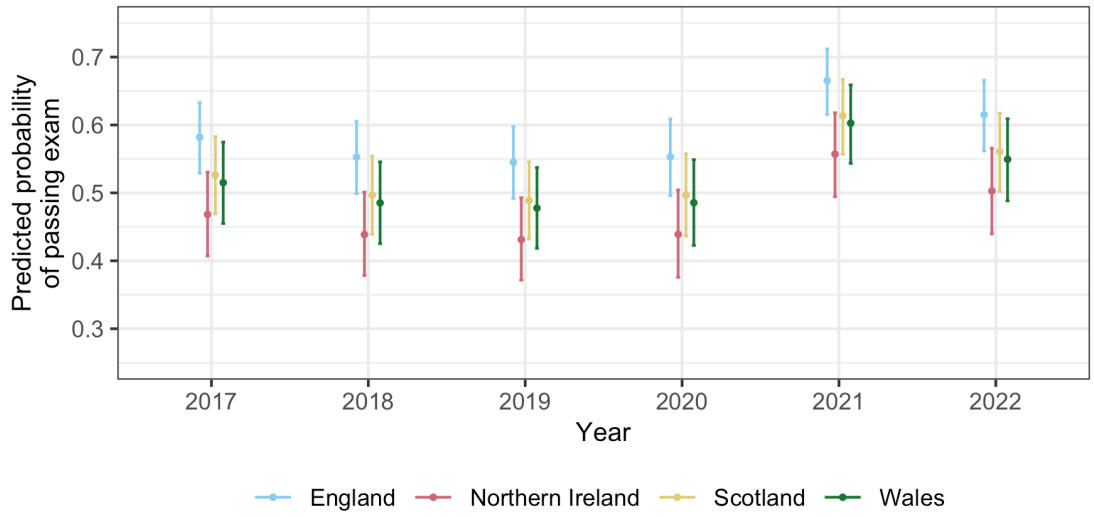
Figure 7. Probability of exam pass/fail over time, by demographics



Plots show predicted probabilities and 95% confidence intervals.

There was an effect of UK nation on exam results, but no interaction. Probability of passing is higher in England than in other nations (figure 8), and this did not change through the pandemic period.

Figure 8. Probability of exam pass/fail over time, by UK nation

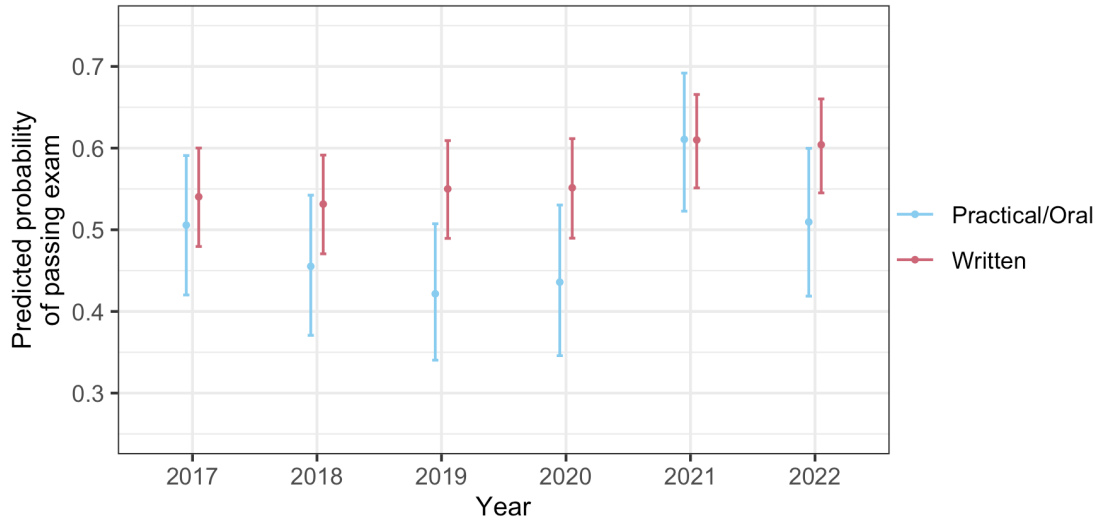


Plots show predicted probabilities and 95% confidence intervals.

Effect of type of exam

There was an effect of type of exam – whether written or practical/oral – and an interaction with year (figure 9). Overall, there is a tendency for written exams to be more likely to result in a pass than other types of exam. However, this varied in years before the pandemic, diverging noticeably in 2019 and 2020. However, in 2021, the predicted probability of passing a written or practical/oral exam was the same.

Figure 9. Probability of exam pass/fail over time, by exam type



Plots show predicted probabilities and 95% confidence intervals.

2.3 Discussion

Analyses of ARCP outcome and exam pass data indicate an effect of the pandemic, as one might expect. The likelihood of both successful and developmental outcomes decreased similarly in 2020, with the introduction of COVID-19 outcomes. This suggests that those receiving COVID-19 outcomes were not just those who would previously have received a developmental outcome, but that *all* trainees were potentially affected by COVID-19 disruption. The COVID-19 outcomes may therefore be considered to have been effective in

providing a safety net for those who would otherwise have progressed, while still providing support for those who would have received a developmental outcome.

The convergence of some demographic differences (of gender, ethnicity and working less than full time) could be inferred as a consequence of the availability of outcomes 10.1 and 10.2 reducing differential attainment at ARCP. However, as the convergence observed is associated with a drop in successful outcomes overall, this may be an artefact of wider effects.

The effect of specialty, where the diagnostic specialties pathology and radiology had a lower probability of successful outcomes in 2020, may reflects the impact of COVID-19 on routine care and consequent availability of training experiences. That there was also a higher probability of outcomes 10.1 and 10.2 in these specialties supports this.

Exam results appear to show a lag in effects of the pandemic to 2021. Findings may reflect the impact of lockdown and the longer period of study and revision provided by the pandemic leading to increased passes (points made in the qualitative data). However, exams were disrupted in many ways, with some cancelled throughout 2020, and others with some diets cancelled and others changed (for example, while spring and autumn diets across all exams in 2020 had 66% and 99% respectively of the numbers of candidates in 2019, the summer diet was available to just 14% of the 2019 numbers). On the return of full exam diets there was therefore a backlog, and there was some prioritisation of those for whom membership exams were more pressing, which may have distorted outcomes through a form of sampling bias.

Variability between England, Wales, Northern Ireland and Scotland was minor, and consistent before during and after the pandemic period, suggesting that there was no differential effect of the pandemic, nor the derogations, across the UK.

2.4 Regression Summary Tables

Regression tables below (tables 8-11) present output from the final, reduced models excluding any effects or interaction which did not contribute to model fit. Tables include coefficient estimates, odds ratios (the exponent of estimates), 95% confidence intervals around the odds ratios, and z-scores and p-values indicating the significance of the odds ratio indicating a difference. In each table, reference groups for factors are as below – meaning that coefficients and odds ratios are of the level stated in the table compared to that reference group. For interaction effects, odds ratios can be calculated by summing the coefficients for each component, and calculating the exponent of that sum.

Reference groups are:

- Year: 2020
- Gender: Female
- Ethnic group binary: White
- Less than full time: Less than full time
- PMQ location binary: UK
- Specialty group: Medicine
- Exam type: Practical/Oral

Table 8. Summary table for regression of ARCP successful outcomes compared to all others.

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
(Intercept)	1.11	3.03	2.83	3.26	30.89	0.000
Year:2017	1.09	2.99	2.66	3.35	18.50	0.000
Year:2018	1.25	3.49	3.11	3.92	20.92	0.000
Year:2019	1.40	4.06	3.61	4.56	23.42	0.000
Year:2021	0.72	2.06	1.86	2.29	13.97	0.000
Year:2022	1.03	2.80	2.52	3.11	19.13	0.000
Gender:Male	-0.08	0.92	0.86	0.98	-2.69	0.007
Ethnic group binary:Other	-0.18	0.83	0.78	0.89	-5.16	0.000
LTFT: Less than full time	0.07	1.07	0.98	1.16	1.46	0.144
Place of PMQ binary:non-UK	-0.36	0.70	0.64	0.76	-8.44	0.000
Specialty group:ACCS	0.36	1.43	1.22	1.67	4.49	0.000
Specialty group:Anaesthetics	0.33	1.39	1.24	1.55	5.72	0.000
Specialty group:Emergency Medicine	0.40	1.49	1.23	1.80	4.10	0.000
Specialty group:GP	1.03	2.80	2.59	3.03	25.62	0.000
Specialty group:Obstetrics and Gynaecology	0.24	1.27	1.10	1.48	3.18	0.001
Specialty group:Ophthalmology	0.20	1.22	0.84	1.76	1.05	0.295
Specialty group:Paediatrics and Child Care	1.56	4.74	3.98	5.66	17.31	0.000
Specialty group:Pathology	-0.68	0.51	0.39	0.66	-5.14	0.000
Specialty group:Psychiatry	1.23	3.44	2.91	4.06	14.63	0.000
Specialty group:Public Health	1.56	4.74	2.23	10.07	4.05	0.000
Specialty group:Radiology	-0.45	0.64	0.55	0.74	-5.96	0.000
Specialty group:Surgery	0.22	1.24	1.13	1.37	4.42	0.000
Nation:Northern Ireland	0.02	1.02	0.85	1.21	0.18	0.859
Nation:Scotland	-0.19	0.82	0.75	0.91	-3.87	0.000
Nation:Wales	-0.07	0.93	0.80	1.08	-0.97	0.330
Year:2017:Gender:Male	-0.16	0.85	0.77	0.94	-3.18	0.001
Year:2018:Gender:Male	-0.11	0.89	0.81	0.99	-2.18	0.029
Year:2019:Gender:Male	-0.17	0.84	0.76	0.93	-3.40	0.001
Year:2021:Gender:Male	-0.11	0.90	0.82	0.98	-2.39	0.017
Year:2022:Gender:Male	-0.15	0.86	0.78	0.94	-3.32	0.001
Year:2017:Ethnic group binary:Other	-0.33	0.72	0.64	0.80	-5.80	0.000
Year:2018:Ethnic group binary:Other	-0.27	0.77	0.68	0.86	-4.69	0.000
Year:2019:Ethnic group binary:Other	-0.30	0.74	0.67	0.83	-5.20	0.000
Year:2021:Ethnic group binary:Other	-0.11	0.90	0.82	0.99	-2.13	0.034
Year:2022:Ethnic group binary:Other	-0.18	0.84	0.75	0.93	-3.41	0.001
Year:2017:LTFT: Less than full time	-0.24	0.79	0.68	0.91	-3.14	0.002
Year:2018:LTFT: Less than full time	-0.44	0.64	0.56	0.74	-5.97	0.000
Year:2019:LTFT: Less than full time	-0.46	0.63	0.55	0.72	-6.48	0.000
Year:2021:LTFT: Less than full time	-0.32	0.73	0.65	0.82	-5.13	0.000
Year:2022:LTFT: Less than full time	-0.39	0.68	0.60	0.77	-6.28	0.000
Year:2017:Place of PMQ binary:non-UK	-0.21	0.81	0.71	0.92	-3.14	0.002
Year:2018:Place of PMQ binary:non-UK	-0.36	0.70	0.61	0.80	-5.35	0.000
Year:2019:Place of PMQ binary:non-UK	-0.32	0.72	0.64	0.82	-4.94	0.000
Year:2021:Place of PMQ binary:non-UK	-0.34	0.71	0.63	0.79	-5.91	0.000
Year:2022:Place of PMQ binary:non-UK	-0.37	0.69	0.62	0.78	-6.21	0.000
Year:2017:Specialty group:ACCS	0.11	1.11	0.84	1.47	0.76	0.448
Year:2018:Specialty group:ACCS	0.20	1.23	0.93	1.63	1.42	0.155
Year:2019:Specialty group:ACCS	-0.14	0.87	0.68	1.11	-1.11	0.269
Year:2021:Specialty group:ACCS	-0.03	0.97	0.77	1.22	-0.23	0.820
Year:2022:Specialty group:ACCS	0.52	1.68	1.29	2.20	3.78	0.000
Year:2017:Specialty group:Anaesthetics	-0.26	0.77	0.65	0.92	-2.96	0.003
Year:2018:Specialty group:Anaesthetics	-0.22	0.80	0.67	0.96	-2.46	0.014
Year:2019:Specialty group:Anaesthetics	0.06	1.06	0.88	1.29	0.65	0.518
Year:2021:Specialty group:Anaesthetics	-0.30	0.74	0.64	0.87	-3.76	0.000
Year:2022:Specialty group:Anaesthetics	0.43	1.54	1.28	1.84	4.68	0.000
Year:2017:Specialty group:Emergency Medicine	-0.21	0.81	0.61	1.09	-1.40	0.163
Year:2018:Specialty group:Emergency Medicine	-0.30	0.74	0.55	0.99	-2.00	0.046
Year:2019:Specialty group:Emergency Medicine	-0.30	0.74	0.54	1.01	-1.89	0.059
Year:2021:Specialty group:Emergency Medicine	0.26	1.29	0.99	1.69	1.87	0.061
Year:2022:Specialty group:Emergency Medicine	0.19	1.21	0.90	1.63	1.27	0.204
Year:2017:Specialty group:GP	0.01	1.01	0.88	1.16	0.18	0.861
Year:2018:Specialty group:GP	-0.01	0.99	0.86	1.13	-0.17	0.864
Year:2019:Specialty group:GP	-0.21	0.81	0.71	0.93	-3.12	0.002
Year:2021:Specialty group:GP	-0.04	0.96	0.86	1.08	-0.64	0.524
Year:2022:Specialty group:GP	-0.21	0.81	0.72	0.91	-3.59	0.000
Year:2017:Specialty group:Obstetrics and Gyanecology	-0.61	0.54	0.43	0.69	-5.15	0.000
Year:2018:Specialty group:Obstetrics and Gyanecology	-0.55	0.58	0.46	0.73	-4.61	0.000
Year:2019:Specialty group:Obstetrics and Gyanecology	-0.27	0.76	0.60	0.98	-2.15	0.031
Year:2021:Specialty group:Obstetrics and Gyanecology	-0.83	0.43	0.36	0.53	-8.09	0.000

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
Year:2022:Specialty group:Obstetrics and Gyanecology	-0.82	0.44	0.36	0.54	-7.87	0.000
Year:2017:Specialty group:Ophthalmology	-0.01	0.99	0.56	1.74	-0.05	0.959
Year:2018:Specialty group:Ophthalmology	0.70	2.01	0.98	4.16	1.89	0.058
Year:2019:Specialty group:Ophthalmology	-0.08	0.93	0.50	1.71	-0.25	0.803
Year:2021:Specialty group:Ophthalmology	-0.25	0.78	0.45	1.34	-0.91	0.365
Year:2022:Specialty group:Ophthalmology	0.18	1.20	0.66	2.17	0.59	0.556
Year:2017:Specialty group:Paediatrics and Child Care	-0.90	0.41	0.32	0.52	-7.28	0.000
Year:2018:Specialty group:Paediatrics and Child Care	-1.18	0.31	0.24	0.39	-9.82	0.000
Year:2019:Specialty group:Paediatrics and Child Care	-0.96	0.38	0.30	0.49	-7.72	0.000
Year:2021:Specialty group:Paediatrics and Child Care	-0.39	0.68	0.53	0.86	-3.21	0.001
Year:2022:Specialty group:Paediatrics and Child Care	-0.51	0.60	0.47	0.77	-3.98	0.000
Year:2017:Specialty group:Pathology	0.99	2.70	1.65	4.43	3.94	0.000
Year:2018:Specialty group:Pathology	0.72	2.05	1.28	3.27	2.99	0.003
Year:2019:Specialty group:Pathology	0.27	1.31	0.84	2.05	1.20	0.228
Year:2021:Specialty group:Pathology	0.12	1.13	0.77	1.64	0.61	0.539
Year:2022:Specialty group:Pathology	0.70	2.02	1.34	3.05	3.34	0.001
Year:2017:Specialty group:Psychiatry	-1.09	0.34	0.27	0.42	-9.46	0.000
Year:2018:Specialty group:Psychiatry	-1.20	0.30	0.24	0.38	-10.24	0.000
Year:2019:Specialty group:Psychiatry	-0.97	0.38	0.30	0.48	-8.07	0.000
Year:2021:Specialty group:Psychiatry	-0.53	0.59	0.47	0.74	-4.58	0.000
Year:2022:Specialty group:Psychiatry	-0.71	0.49	0.39	0.61	-6.22	0.000
Year:2017:Specialty group:Public Health	-0.48	0.62	0.17	2.20	-0.74	0.459
Year:2018:Specialty group:Public Health	0.74	2.10	0.25	17.51	0.69	0.492
Year:2019:Specialty group:Public Health	-1.09	0.34	0.11	1.04	-1.89	0.059
Year:2021:Specialty group:Public Health	-0.82	0.44	0.16	1.24	-1.55	0.120
Year:2022:Specialty group:Public Health	-0.52	0.59	0.18	1.98	-0.85	0.396
Year:2017:Specialty group:Radiology	0.67	1.95	1.50	2.54	5.00	0.000
Year:2018:Specialty group:Radiology	0.60	1.82	1.40	2.36	4.48	0.000
Year:2019:Specialty group:Radiology	0.60	1.83	1.41	2.37	4.56	0.000
Year:2021:Specialty group:Radiology	0.32	1.38	1.12	1.71	2.99	0.003
Year:2022:Specialty group:Radiology	0.58	1.78	1.42	2.23	5.06	0.000
Year:2017:Specialty group:Surgery	0.02	1.02	0.87	1.19	0.24	0.814
Year:2018:Specialty group:Surgery	-0.27	0.76	0.66	0.89	-3.47	0.001
Year:2019:Specialty group:Surgery	-0.32	0.72	0.62	0.84	-4.17	0.000
Year:2021:Specialty group:Surgery	-0.78	0.46	0.40	0.52	-11.69	0.000
Year:2022:Specialty group:Surgery	-0.60	0.55	0.48	0.63	-8.55	0.000
Year:2017:Nation:Northern Ireland	-0.07	0.93	0.69	1.25	-0.49	0.624
Year:2018:Nation:Northern Ireland	-0.26	0.77	0.58	1.02	-1.85	0.065
Year:2019:Nation:Northern Ireland	-0.16	0.85	0.64	1.14	-1.06	0.289
Year:2021:Nation:Northern Ireland	0.15	1.16	0.89	1.50	1.09	0.276
Year:2022:Nation:Northern Ireland	0.19	1.20	0.91	1.59	1.31	0.192
Year:2017:Nation:Scotland	0.24	1.27	1.08	1.49	2.88	0.004
Year:2018:Nation:Scotland	0.29	1.33	1.13	1.57	3.40	0.001
Year:2019:Nation:Scotland	0.27	1.31	1.11	1.55	3.19	0.001
Year:2021:Nation:Scotland	0.38	1.46	1.27	1.69	5.14	0.000
Year:2022:Nation:Scotland	0.20	1.22	1.05	1.42	2.66	0.008
Year:2017:Nation:Wales	-0.11	0.90	0.71	1.13	-0.94	0.347
Year:2018:Nation:Wales	-0.38	0.68	0.55	0.86	-3.32	0.001
Year:2019:Nation:Wales	-0.57	0.57	0.46	0.71	-5.12	0.000
Year:2021:Nation:Wales	-0.10	0.90	0.74	1.10	-1.00	0.317
Year:2022:Nation:Wales	-0.12	0.89	0.72	1.09	-1.13	0.259

Table 9. Summary table for regression of ARCP developmental outcomes compared to all others.

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
(Intercept)	-3.50	0.03	0.03	0.03	-56.87	0.000
Year:2017	1.18	3.25	2.80	3.76	15.71	0.000
Year:2018	1.05	2.86	2.47	3.32	14.01	0.000
Year:2019	0.95	2.59	2.24	3.00	12.73	0.000
Year:2021	-0.57	0.57	0.47	0.68	-6.25	0.000
Year:2022	0.76	2.14	1.85	2.48	10.20	0.000
Gender:Male	0.28	1.32	1.19	1.46	5.31	0.000
Ethnic group binary:Other	0.43	1.53	1.47	1.60	19.45	0.000
LTFT: Less than full time	0.63	1.88	1.66	2.14	9.81	0.000
Place of PMQ binary:non-UK	0.79	2.20	1.97	2.45	14.16	0.000
Specialty group:ACCS	0.10	1.11	0.84	1.45	0.73	0.467
Specialty group:Anaesthetics	0.04	1.04	0.85	1.27	0.36	0.716
Specialty group:Emergency Medicine	0.18	1.19	0.88	1.61	1.16	0.247
Specialty group:GP	-0.30	0.74	0.65	0.84	-4.61	0.000
Specialty group:Obstetrics and Gynaecology	0.52	1.68	1.33	2.12	4.40	0.000

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
Specialty group:Ophthalmology	0.04	1.04	0.53	2.03	0.11	0.915
Specialty group:Paediatrics and Child Care	-0.58	0.56	0.42	0.73	-4.21	0.000
Specialty group:Pathology	0.69	2.00	1.31	3.05	3.22	0.001
Specialty group:Psychiatry	0.19	1.21	0.98	1.50	1.78	0.075
Specialty group:Public Health	-0.53	0.59	0.18	1.93	-0.87	0.383
Specialty group:Radiology	-0.07	0.93	0.69	1.26	-0.45	0.652
Specialty group:Surgery	0.70	2.01	1.73	2.34	9.07	0.000
Nation:Northern Ireland	0.08	1.08	0.96	1.21	1.30	0.193
Nation:Scotland	-0.10	0.91	0.85	0.97	-2.89	0.004
Nation:Wales	0.38	1.45	1.34	1.58	8.89	0.000
Year:2017:Gender:Male	-0.01	0.99	0.87	1.12	-0.21	0.834
Year:2018:Gender:Male	-0.08	0.93	0.81	1.06	-1.15	0.250
Year:2019:Gender:Male	-0.02	0.98	0.86	1.12	-0.31	0.754
Year:2021:Gender:Male	0.14	1.15	1.00	1.32	2.01	0.045
Year:2022:Gender:Male	0.02	1.02	0.90	1.16	0.29	0.773
Year:2017:LTFT: Less than full time	-0.48	0.62	0.52	0.74	-5.25	0.000
Year:2018:LTFT: Less than full time	-0.30	0.74	0.62	0.88	-3.40	0.001
Year:2019:LTFT: Less than full time	-0.28	0.76	0.64	0.90	-3.23	0.001
Year:2021:LTFT: Less than full time	-0.09	0.91	0.77	1.08	-1.04	0.300
Year:2022:LTFT: Less than full time	-0.26	0.77	0.66	0.90	-3.31	0.001
Year:2017:Place of PMQ binary:non-UK	-0.22	0.80	0.69	0.92	-3.09	0.002
Year:2018:Place of PMQ binary:non-UK	-0.13	0.88	0.76	1.02	-1.75	0.080
Year:2019:Place of PMQ binary:non-UK	-0.11	0.89	0.78	1.03	-1.60	0.109
Year:2021:Place of PMQ binary:non-UK	0.04	1.04	0.90	1.20	0.55	0.582
Year:2022:Place of PMQ binary:non-UK	-0.01	0.99	0.86	1.12	-0.22	0.824
Year:2017:Specialty group:ACCS	-0.51	0.60	0.42	0.86	-2.76	0.006
Year:2018:Specialty group:ACCS	-0.64	0.53	0.37	0.76	-3.41	0.001
Year:2019:Specialty group:ACCS	-0.37	0.69	0.49	0.97	-2.15	0.031
Year:2021:Specialty group:ACCS	0.59	1.80	1.24	2.62	3.07	0.002
Year:2022:Specialty group:ACCS	-0.76	0.47	0.32	0.67	-4.06	0.000
Year:2017:Specialty group:Anaesthetics	-0.16	0.86	0.67	1.09	-1.24	0.214
Year:2018:Specialty group:Anaesthetics	-0.17	0.84	0.66	1.08	-1.34	0.181
Year:2019:Specialty group:Anaesthetics	-0.52	0.60	0.46	0.77	-3.90	0.000
Year:2021:Specialty group:Anaesthetics	0.17	1.19	0.88	1.60	1.14	0.254
Year:2022:Specialty group:Anaesthetics	-0.96	0.38	0.29	0.51	-6.79	0.000
Year:2017:Specialty group:Emergency Medicine	-0.30	0.74	0.51	1.08	-1.57	0.117
Year:2018:Specialty group:Emergency Medicine	-0.23	0.79	0.54	1.15	-1.22	0.222
Year:2019:Specialty group:Emergency Medicine	-0.23	0.79	0.54	1.17	-1.15	0.249
Year:2021:Specialty group:Emergency Medicine	0.63	1.88	1.28	2.76	3.23	0.001
Year:2022:Specialty group:Emergency Medicine	-0.33	0.72	0.49	1.05	-1.70	0.090
Year:2017:Specialty group:GP	-0.64	0.53	0.45	0.63	-7.28	0.000
Year:2018:Specialty group:GP	-0.58	0.56	0.47	0.67	-6.59	0.000
Year:2019:Specialty group:GP	-0.45	0.64	0.54	0.75	-5.32	0.000
Year:2021:Specialty group:GP	0.93	2.54	2.11	3.05	9.93	0.000
Year:2022:Specialty group:GP	-0.10	0.91	0.78	1.06	-1.22	0.222
Year:2017:Specialty group:Obstetrics and Gynaecology	-0.04	0.96	0.71	1.28	-0.30	0.766
Year:2018:Specialty group:Obstetrics and Gynaecology	-0.13	0.88	0.65	1.18	-0.86	0.392
Year:2019:Specialty group:Obstetrics and Gynaecology	-0.42	0.66	0.48	0.89	-2.74	0.006
Year:2021:Specialty group:Obstetrics and Gynaecology	0.72	2.06	1.49	2.83	4.42	0.000
Year:2022:Specialty group:Obstetrics and Gynaecology	-0.13	0.88	0.66	1.17	-0.88	0.377
Year:2017:Specialty group:Ophthalmology	-0.06	0.94	0.42	2.09	-0.14	0.885
Year:2018:Specialty group:Ophthalmology	-0.84	0.43	0.17	1.09	-1.78	0.075
Year:2019:Specialty group:Ophthalmology	-0.06	0.94	0.41	2.16	-0.15	0.881
Year:2021:Specialty group:Ophthalmology	-0.55	0.58	0.15	2.20	-0.80	0.421
Year:2022:Specialty group:Ophthalmology	-0.52	0.60	0.24	1.48	-1.11	0.267
Year:2017:Specialty group:Paediatrics and Child Care	0.01	1.01	0.74	1.39	0.08	0.935
Year:2018:Specialty group:Paediatrics and Child Care	0.29	1.34	0.98	1.83	1.81	0.070
Year:2019:Specialty group:Paediatrics and Child Care	0.03	1.04	0.75	1.43	0.21	0.832
Year:2021:Specialty group:Paediatrics and Child Care	0.62	1.85	1.29	2.66	3.32	0.001
Year:2022:Specialty group:Paediatrics and Child Care	-0.26	0.77	0.55	1.08	-1.50	0.135
Year:2017:Specialty group:Pathology	-1.02	0.36	0.20	0.66	-3.29	0.001

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
Year:2018:Specialty group:Pathology	-0.67	0.51	0.29	0.91	-2.29	0.022
Year:2019:Specialty group:Pathology	-0.26	0.77	0.44	1.34	-0.92	0.360
Year:2021:Specialty group:Pathology	0.36	1.43	0.77	2.65	1.12	0.261
Year:2022:Specialty group:Pathology	-0.46	0.63	0.36	1.10	-1.61	0.107
Year:2017:Specialty group:Psychiatry	-0.37	0.69	0.53	0.90	-2.72	0.006
Year:2018:Specialty group:Psychiatry	-0.29	0.75	0.57	0.98	-2.13	0.033
Year:2019:Specialty group:Psychiatry	-0.56	0.57	0.43	0.75	-3.94	0.000
Year:2021:Specialty group:Psychiatry	0.45	1.57	1.16	2.12	2.94	0.003
Year:2022:Specialty group:Psychiatry	-0.46	0.63	0.48	0.82	-3.36	0.001
Year:2017:Specialty group:Public Health	-0.41	0.66	0.14	3.17	-0.52	0.605
Year:2018:Specialty group:Public Health	-1.60	0.20	0.02	2.01	-1.36	0.173
Year:2019:Specialty group:Public Health	0.18	1.20	0.28	5.10	0.24	0.809
Year:2021:Specialty group:Public Health	0.34	1.40	0.22	8.92	0.36	0.719
Year:2022:Specialty group:Public Health	-0.50	0.61	0.11	3.28	-0.58	0.563
Year:2017:Specialty group:Radiology	-0.06	0.94	0.65	1.36	-0.33	0.741
Year:2018:Specialty group:Radiology	0.01	1.01	0.70	1.46	0.05	0.957
Year:2019:Specialty group:Radiology	-0.03	0.97	0.67	1.40	-0.18	0.861
Year:2021:Specialty group:Radiology	0.63	1.88	1.25	2.82	3.05	0.002
Year:2022:Specialty group:Radiology	0.37	1.45	1.02	2.05	2.07	0.038
Year:2017:Specialty group:Surgery	-0.84	0.43	0.36	0.53	-8.45	0.000
Year:2018:Specialty group:Surgery	-0.59	0.56	0.46	0.67	-5.98	0.000
Year:2019:Specialty group:Surgery	-0.54	0.58	0.48	0.70	-5.56	0.000
Year:2021:Specialty group:Surgery	0.52	1.69	1.36	2.09	4.76	0.000
Year:2022:Specialty group:Surgery	-0.53	0.59	0.49	0.72	-5.36	0.000

Table 10. Summary table for regression of ARCP COVID-19 outcomes compared to all others.

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
(Intercept)	-1.18	0.31	0.29	0.33	-37.74	0.000
Ethnic group binary:Other	0.11	1.11	1.06	1.17	3.99	0.000
Year:2021	-0.49	0.61	0.56	0.67	-10.93	0.000
Year:2022	-1.57	0.21	0.19	0.23	-26.52	0.000
LTFT: Less than full time	-0.43	0.65	0.59	0.72	-8.67	0.000
Place of PMQ binary:non-UK	0.03	1.03	0.95	1.12	0.69	0.490
Specialty group:ACCS	-0.46	0.63	0.54	0.74	-5.68	0.000
Specialty group:Anaesthetics	-0.38	0.68	0.61	0.76	-6.67	0.000
Specialty group:Emergency Medicine	-0.51	0.60	0.49	0.74	-4.96	0.000
Specialty group:GP	-1.00	0.37	0.34	0.40	-23.86	0.000
Specialty group:Obstetrics and Gynaecology	-0.41	0.66	0.57	0.78	-5.10	0.000
Specialty group:Ophthalmology	-0.20	0.82	0.57	1.17	-1.10	0.271
Specialty group:Paediatrics and Child Care	-1.77	0.17	0.14	0.21	-16.36	0.000
Specialty group:Pathology	0.59	1.81	1.41	2.31	4.72	0.000
Specialty group:Psychiatry	-2.25	0.11	0.08	0.14	-16.00	0.000
Specialty group:Public Health	-1.79	0.17	0.07	0.41	-3.86	0.000
Specialty group:Radiology	0.48	1.61	1.40	1.86	6.66	0.000
Specialty group:Surgery	-0.54	0.58	0.52	0.64	-10.49	0.000
Nation:Northern Ireland	-0.05	0.95	0.80	1.15	-0.50	0.616
Nation:Scotland	0.26	1.30	1.18	1.44	5.19	0.000
Nation:Wales	0.04	1.05	0.90	1.22	0.58	0.565
Year:2021:LTFT: Less than full time	0.36	1.43	1.24	1.66	4.92	0.000
Year:2022:LTFT: Less than full time	0.49	1.63	1.36	1.95	5.25	0.000
Year:2021:Place of PMQ binary:non-UK	0.35	1.42	1.26	1.61	5.58	0.000
Year:2022:Place of PMQ binary:non-UK	0.17	1.18	1.00	1.40	2.00	0.046
Year:2021:Specialty group:ACCS	-0.40	0.67	0.52	0.88	-2.93	0.003
Year:2022:Specialty group:ACCS	-1.07	0.34	0.21	0.55	-4.38	0.000
Year:2021:Specialty group:Anaesthetics	0.21	1.24	1.05	1.45	2.57	0.010
Year:2022:Specialty group:Anaesthetics	-0.15	0.86	0.68	1.08	-1.28	0.199
Year:2021:Specialty group:Emergency Medicine	-1.12	0.33	0.23	0.47	-5.94	0.000
Year:2022:Specialty group:Emergency Medicine	-2.50	0.08	0.03	0.26	-4.25	0.000
Year:2021:Specialty group:GP	-1.39	0.25	0.21	0.29	-16.34	0.000
Year:2022:Specialty group:GP	-2.49	0.08	0.06	0.12	-12.51	0.000
Year:2021:Specialty group:Obstetrics and Gyanecology	0.65	1.92	1.55	2.38	5.89	0.000
Year:2022:Specialty group:Obstetrics and Gyanecology	1.07	2.91	2.28	3.71	8.57	0.000
Year:2021:Specialty group:Ophthalmology	0.31	1.37	0.79	2.37	1.12	0.262
Year:2022:Specialty group:Ophthalmology	0.02	1.02	0.49	2.13	0.04	0.965
Year:2021:Specialty group:Paediatrics and Child Care	0.15	1.17	0.86	1.58	1.01	0.313
Year:2022:Specialty group:Paediatrics and Child Care	0.38	1.46	0.99	2.17	1.90	0.057

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
Year:2021:Specialty group:Pathology	-0.30	0.74	0.50	1.09	-1.53	0.126
Year:2022:Specialty group:Pathology	-1.12	0.33	0.18	0.60	-3.57	0.000
Year:2021:Specialty group:Psychiatry	0.42	1.52	1.03	2.22	2.14	0.033
Year:2022:Specialty group:Psychiatry	0.60	1.81	1.13	2.92	2.45	0.014
Year:2021:Specialty group:Public Health	0.83	2.29	0.70	7.52	1.36	0.173
Year:2022:Specialty group:Public Health	0.74	2.10	0.39	11.24	0.87	0.385
Year:2021:Specialty group:Radiology	-0.48	0.62	0.50	0.77	-4.33	0.000
Year:2022:Specialty group:Radiology	-1.63	0.20	0.13	0.30	-7.65	0.000
Year:2021:Specialty group:Surgery	0.71	2.03	1.76	2.34	9.84	0.000
Year:2022:Specialty group:Surgery	1.04	2.82	2.37	3.34	11.85	0.000
Year:2021:Nation:Northern Ireland	-0.45	0.63	0.46	0.87	-2.82	0.005
Year:2022:Nation:Northern Ireland	-1.21	0.30	0.16	0.55	-3.92	0.000
Year:2021:Nation:Scotland	-0.60	0.55	0.46	0.65	-7.03	0.000
Year:2022:Nation:Scotland	0.02	1.02	0.83	1.23	0.15	0.879
Year:2021:Nation:Wales	0.11	1.12	0.89	1.40	0.99	0.323
Year:2022:Nation:Wales	-0.97	0.38	0.25	0.59	-4.31	0.000

Table 11. Summary table for regression of exam pass/fail.

	Est.	exp(Est.)	2.50%	97.50%	z val.	p
(Intercept)	1.56	4.74	3.28	6.86	8.27	0.000
Gender:Male	-0.05	0.95	0.91	1.00	-1.94	0.052
Year:2017	-0.04	0.96	0.76	1.21	-0.37	0.713
Year:2018	-0.06	0.94	0.74	1.18	-0.54	0.591
Year:2019	-0.17	0.84	0.67	1.06	-1.47	0.142
Year:2021	0.52	1.68	1.31	2.17	4.06	0.000
Year:2022	-0.02	0.98	0.76	1.28	-0.12	0.904
Ethnic group binary:Other	-0.83	0.44	0.38	0.50	-11.18	0.000
Place of PMQ binary:non-UK	-1.98	0.14	0.12	0.16	-21.71	0.000
Nation:Northern Ireland	-0.46	0.63	0.56	0.72	-6.95	0.000
Nation:Scotland	-0.23	0.80	0.73	0.87	-5.22	0.000
Nation:Wales	-0.27	0.76	0.68	0.85	-4.72	0.000
LTFT: Less than full time	-0.29	0.75	0.69	0.81	-6.97	0.000
Exam type:Other	0.46	1.59	1.03	2.46	2.08	0.037
Year:2017:Ethnic group binary:Other	0.10	1.11	0.93	1.32	1.11	0.265
Year:2018:Ethnic group binary:Other	0.00	1.00	0.84	1.20	0.02	0.987
Year:2019:Ethnic group binary:Other	-0.14	0.87	0.73	1.04	-1.50	0.133
Year:2021:Ethnic group binary:Other	0.02	1.02	0.84	1.23	0.16	0.873
Year:2022:Ethnic group binary:Other	0.17	1.18	0.97	1.44	1.65	0.099
Year:2017:Place of PMQ binary:non-UK	0.55	1.73	1.37	2.19	4.62	0.000
Year:2018:Place of PMQ binary:non-UK	0.28	1.33	1.06	1.67	2.42	0.016
Year:2019:Place of PMQ binary:non-UK	0.36	1.44	1.15	1.80	3.19	0.001
Year:2021:Place of PMQ binary:non-UK	0.36	1.43	1.14	1.79	3.15	0.002
Year:2022:Place of PMQ binary:non-UK	0.46	1.58	1.25	1.99	3.89	0.000
Year:2017:Exam type:Written	-0.33	0.72	0.56	0.93	-2.56	0.010
Year:2018:Exam type:Written	-0.16	0.85	0.67	1.09	-1.25	0.211
Year:2019:Exam type:Written	0.05	1.05	0.83	1.35	0.42	0.673
Year:2021:Exam type:Written	-0.47	0.63	0.48	0.82	-3.42	0.001
Year:2022:Exam type:Written	-0.08	0.92	0.70	1.22	-0.56	0.578

References

[1] R Core Team. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria, 2023 [https://www.R-project.org/]

[2] Bates D, Maechler M, Bolker B, Walker S. Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software, 2015, 67(1), 1-48. doi:10.18637/jss.v067.i01.

[3] Long JA. _jtools: Analysis and Presentation of Social Scientific Data. R package version 2.2.0, 2022 <https://cran.r-project.org/package=jtools>

[4] Lüdecke D. ggeffects: Tidy Data Frames of Marginal Effects from Regression Models. Journal of Open Source Software, 2018, 3(26):772. doi:10.21105/joss.00772