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Institutional choice among medical applicants: a profile paper for The United Kingdom Medical Applicant Cohort Study (UKMACS) prospective longitudinal cohort study

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ABSTRACT

Purpose To generate a large cohort of those in 2019 seriously considering applying to study Medicine, collecting data on a range of socioeconomic and other demographic factors that influence choice of medical schools and to link to other datasets to form a longitudinal study of progress through medical school and careers in medicine.

Design Cross-sectional questionnaire studies, part of the longitudinal UK Medical Applicant Cohort Study (UKMACS).

Setting UK medical school admissions in 2020.

Participants UK residents aged 16+ and seriously considering applying to study Medicine. The cohort was primarily drawn from those registering in 2019 for the U(K)CAT (University Clinical Aptitude Test (formerly the UK Clinical Aptitude Test)) with additional potential applicants responding to an open call. Participants consented to their data being linked within the UK Medical Education Database.

Findings to date UKMACS Wave 1 questionnaire respondents consisted of 6391 consenting respondents from across the UK. In 2019, 14 980 of the 17 470 UK-domiciled medicine applicants were first-time applicants. The questionnaires show that many of these applicants have a need for more help and guidance to make informed choices, with less advantaged groups reporting themselves as being at a disadvantage when applying due to limited understanding of information and limited access to guidance to enable informed and effective decision-making.

Future plans To link the cohort with successive Universities and Colleges Admissions Service and other datasets to analyse outcomes of applications and establish national longitudinal evidence to understand how medical choices are made and how they impact on educational, career and workforce outcomes.

INTRODUCTION

Research consistently shows the lack of social mobility in medicine, which continues to be one of the most inaccessible professions.[1] For example, in the UK, only around 15% of the students accepted onto medical courses come from the most deprived areas compared with about 45% of the students come from the most affluent areas.[2,3]

Doctor shortages, particularly in some geographic areas, affect the quality of service that patients receive.[4,5] The absence of medical schools in many parts of the UK is thought to contribute to the lack of doctors in these areas,[6] as well as limiting access to medical careers for individuals from deprived backgrounds who are more likely to want to attend university locally.[7] Yet, the UK government has repeatedly stated a commitment to supporting the National Health Service (NHS) workforce:

> As we look beyond the pandemic, it's incredibly important we safeguard the future of our NHS by ensuring there is a pipeline of high-quality staff to bolster

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Study constitutes the largest and most recent quantitative exploration of UK medical school applicant experiences as the baseline of an ongoing longitudinal study of the 2019 cohort.

⇒ Relatively large nationwide sample linked to administrative data to track impact of choices on medical career outcomes.

⇒ Includes a wide range of sociodemographic groups with data on various sociodemographic factors that predict medical school choice, attainment and progression.

⇒ Potential for response bias as targeted at those seriously considering applying to medical school and administered online using multiple recruitment methods.

⇒ Questionnaire provides a snapshot of applicant views (which may change throughout process), while the longitudinal study aspect allows for tracking to measure impact of pandemic on medical applicants.

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the workforce in the years ahead.(Secretary of State for Health and Social Care, August 2021)

This pipeline is restricted though as the number of medical students is capped by the UK Government. In 2018, five new medical schools were created in under-doctored areas, which also had a specific remit to widen participation. In addition, further medical student places were allocated to existing medical schools, based partly on their Widening Participation (WP) strategies. This increased the number of universities in the UK offering medical degree programmes to 42, each with different admissions requirements.[8]

Little is known about how informed the applicants are about different medical schools, nor is it clear which criteria applicants use to narrow down to a choice of four medical schools (the maximum it is possible to apply to within the Universities and Colleges Admissions Service, UCAS), or how applicants who receive more than one offer choose between medical schools. Yet, government policy focuses on enabling students to make informed choices about higher education:

> We want to ensure that students from all backgrounds are able to enter and succeed in higher education. Students should be able to make informed choices about their studies, with access to a diverse range of provision which meets their needs. (Office for Students website, April 2021)

Research on the choices made by university applicants continues to show the impact of social background and context.[9–11] In contrast, policy makers have largely followed the human-capital model that has dominated discussions of student choice in the USA[12] with students conceptualised as rational calculators primarily weighing the costs and benefits of Higher Education and the relative quality of institutions and courses. There is little understanding of how student choices are shaped by several other factors such as psychological traits, cognitive strategies (eg, heuristics and cognitive shortcuts), aspirations, sociopsychological identities and emotional responses, and how these might vary by social background.

Specifically in the UK context, medical schools are heavily over-subscribed and competition for places is fierce, with applications to study Medicine continuing to rise. For example, in 2020, there was a record number of 18 500 UK applicants for the 9000 places.[13] As such, a substantial amount of the literature on medical school admissions examines the effectiveness of selection processes used by UK medical schools to choose between highly qualified candidates.[14] Medical schools seek to widen participation, and there is a considerable literature on how applicants from diverse socioeconomic and demographic backgrounds choose whether or not to study medicine.[15–17] This research focuses largely on the outcomes of selection, with relatively little research exploring how aspiring medical students, including those

from under-represented groups, select which medical schools to apply to.

Medical school choice is important to study because it has considerable impact on applicants as well as on the medical workforce. Once at medical school, over 90% of medical students end up working as doctors in the National Health Service[18] but graduates of different UK medical schools differ significantly in their postgraduate academic and career outcomes, including whether they enter shortage specialties such as General Practice and Psychiatry.[19–22] This may be due to variation in medical school admissions processes and differences in undergraduate and postgraduate training, but it may also be due to applicants with different characteristics and aspirations choosing different medical schools to apply to. There is therefore a considerable need for national longitudinal evidence to understand how medical choices are made and how they impact on educational, career and workforce outcomes.

We present this cohort profile as a foundational paper for future research. Here, we describe the design and methodology of a prospective national longitudinal cohort study of aspiring medical students, started in 2019 as part of the UK Medical Applicant Cohort Study (UKMACS), a national mixed-methods programme of research into medical school choice funded by the National Institute for Health Research. Using data from applicants to medical schools across the UK, UKMACS aimed to answer the research question: 'how do medical applicant characteristics influence choice of medical school and application success?'. Through linkage to administrative data on undergraduate and postgraduate medical education and training outcomes within the United Kingdom Medical Education Database (UKMED),[23] the study also aimed to enable longitudinal research on the outcomes of medical selection and causes of medium-and long-term academic and career outcomes in a cohort of medical students and doctors in the UK. Further papers will focus on analysis and interpretation of this data.

Our study is informed by the literature on institutional (university) choice within higher education more widely (see Hemsley-Brown and Oplatka[24] for a review). This literature emphasises the complexity of institutional choice, and covers decision-making processes,[25] the acquisition and use of information and how it is constrained by social, academic, psychological, information and other contextual factors,[10 26] and the different experiences, values and priorities of applicants from diverse socioeconomic, cultural and educational backgrounds.[27]

To examine applicant choice of medical schools, we followed Dawes and Brown's[28] model, which is based on consumer brand choice and Hossler and Gallagher's[29] three-phase model of college choice. In this model, applicants filter out universities using relatively simple and broad criteria, often based on what is not wanted, before engaging in a more detailed analysis of a reduced set of options. Applicants initially define and consider universities on various attributes, assigning attributes to all the

universities they are aware of (the awareness set). They then remove universities without the desired attributes to form a consideration set, from which they select a choice set of universities they want to apply to. Generating each set may be an iterative process, whereby applicants focus on different attributes with each phase, and return to evaluate already-considered options.[28]

An important part of Dawes and Brown's model involves the acquisition and use of information about different Higher Education Institutions (HEIs). Increasing information, support and guidance for university choice has also become a policy priority in England, where the English HE regulator Office for Students (OfS) has linked it directly to improved social mobility and student success. A review commissioned by the OfS concluded that the acquisition and use of information in HE choice is influenced by a wide variety of social, psychological and environmental factors, and thus varies widely between individuals.[30] The review also identified a lack of research about how applicants from lower socioeconomic groups engage with information, although noting that 'they typically consultant fewer sources' (p67). In this study, we explore how applicant background factors and the availability of information sources influence the medical school choices of applicants. We call this applicant-focused process 'medical school choice', while recognising that such 'choices' are constrained and facilitated by individual and contextual social, economic, education and cultural factors.[10 11 31 32]

COHORT DESCRIPTION
Patient and public involvement
Project Steering Group included a patient representative and members of the public (including medical student and medical school applicant members) who were involved in the design and development of the questionnaires.

Setting
Longitudinal cohort study of the UK medical school applications in the 2019/2020 application cycle. Uses questionnaire data from three waves of questionnaire linked to administrative data. Wave 1 of data collection between May and October 2019 with a first follow-up (Wave 2) between November 2019 and January 2020, and an additional COVID-19-specific (Wave 3) follow-up in April 2020.

Applying to study medicine in the UK
The deadline for applicants to Medicine for entry in October 2020 to submit their application to UCAS was 15 October 2019. This October deadline is earlier than the January deadline for other university courses, with the exception of Veterinary Medicine, Dentistry and any courses at the universities of Oxford and Cambridge. Further details on the process of applying to study medicine in the UK are detailed in online supplemental file

1. See figure 1 for an overview of the 2019/2020 medical school applications timeline.

Population
Registrants to the UCAT (University Clinical Aptitude Test (formerly the UK Clinical Aptitude Test)) within the 2019 test cycle and UK applicants to medicine by the October 2019 UCAS deadline.

Eligibility criteria
Inclusion criteria
► Considering applying to a medical degree course at a UK HEI by the 15 October 2019 UCAS deadline, including registering for UCAT, BioMedical Admissions Test (BMAT) or Graduate Medical School Admissions Test (GAMSAT).
► Aged 16 or over.
► Resident in the UK or Islands or eligible for home university tuition fee status.

Exclusion criteria
► Not considering applying to a medical degree course at a UK HEI by the 15 October 2019 UCAS deadline.
► Aged under 16.
► Not resident in the UK or Islands or not eligible for Home university tuition fee status.

Questionnaire design and development
The UKMACS questionnaire was developed in the following way, which closely follows Artino et al[33]:
1. Conducted a literature review using relevant prior research to identify existing validated items that could be used or adapted.
2. Conducted interviews and focus groups[34] with medical school applicants and first year students to identify and define the priorities and strategies of potential applicants.
3. Synthesised the literature review and interviews/focus groups to ensure that the constructs and models underlying the questionnaires made theoretical sense and were accessible to participants.
4. Developed items that were clear, understandable and written in accordance with current best practices in survey design.
5. Gained expert validation from expert members of the project Steering Group to assess how clear and relevant the items were and review the format and administration process of the surveys.
6. Conducted a cognitive interview with a medical student Steering Group member (similar to participants) to ensure that respondents would interpret items in the manner intended.
7. Conducted pilot testing with groups similar to participants to check for adequate item variance, reliability and convergent/discriminant validity with respect to other measures.

See online supplemental file 2 for an overview of questionnaire items and variables, and online supplemental files 3–5 for the questionnaires.
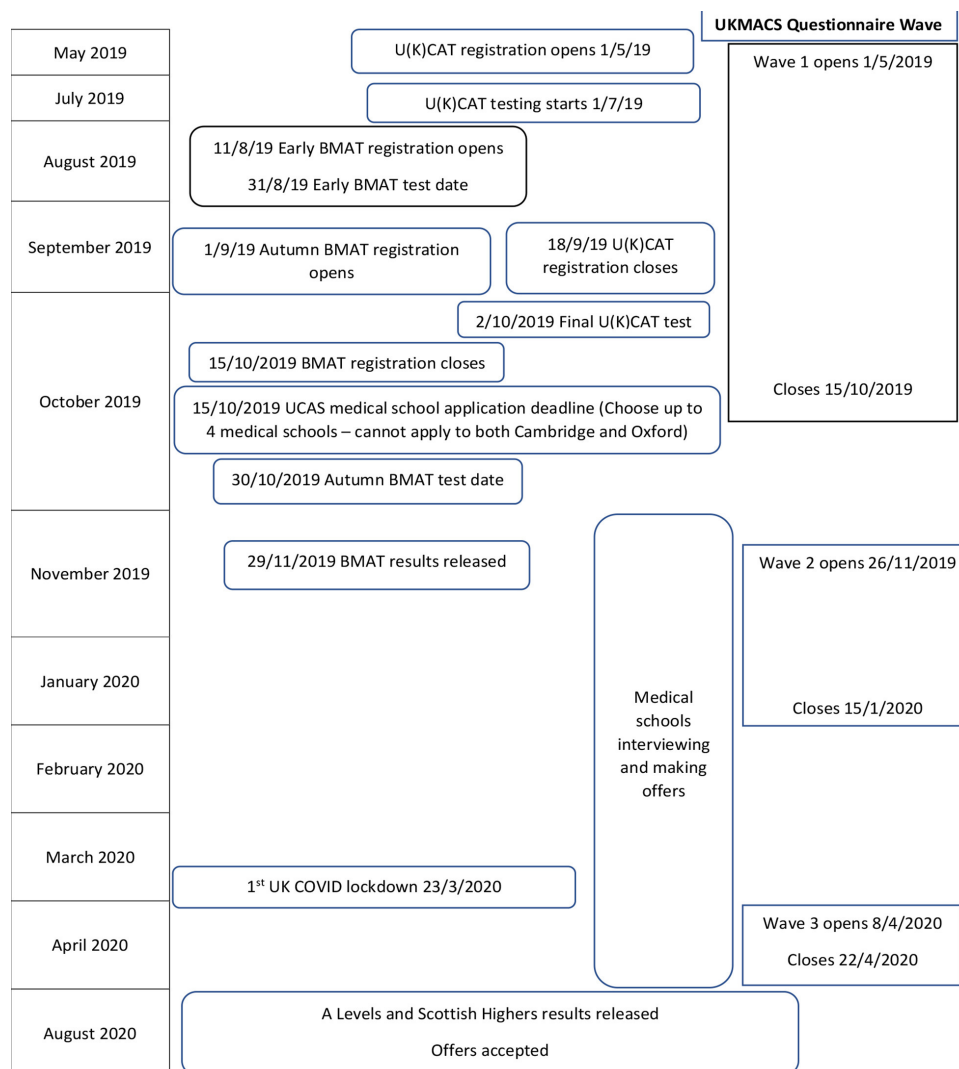
Figure 1 The 2019/2020 medical school applications timeline. BMAT, BioMedical Admissions Test; UCAS, Universities and Colleges Admissions Service; U(K)CAT, University Clinical Aptitude Test (formerly the UK Clinical Aptitude Test); UKMACS, UK Medical Applicant Cohort Study.

Recruitment, data collection methods, ethics and external data sources

Data for all Waves were collected primarily via an online questionnaire hosted on the JISC Online Surveys platform https://www.onlinesurveys.ac.uk/.

Wave 1 recruitment and data collection

During the UCAT registration process, all UCAT registrants in 2019 were presented with a binary yes/no question about whether they consented to UCAT sending their contact details (full name, address, email address, telephone number) to the UKMACS research team so they could receive a link to take part in the study. UCAT sent the contact details of consenting participants to the UKMACS team on a weekly basis throughout the UCAT registration period from 1 May 2019 to 2 October 2019. Between 7 May 2019 and 14 October 2019, the research team emailed each week's consenting participants a study invitation, a study information sheet and a personalised weblink to the consent form and questionnaire with the

name, email address and UCAT registration ID fields pre-populated.

An additional route to participation was via a non-personalised (general) weblink to the consent form and questionnaire without pre-populated fields. This weblink and the participant information sheet were hosted on the BMAT and GAMSAT registration webpages and the Medical Schools Council medical school application webpage. Flyers with the weblink were circulated by UK medical school widening participation schemes and at open days between May and October 2019. The aim was primarily to enable non-UCAT registrants to take part although it was possible for UCAT registrants to take part via this general link.

Two email reminders were sent at 4 and 8 day intervals, followed by two SMS text message reminders. A pilot study compared the effectiveness of three types of postal reminders to participants' homes: a paper version of the questionnaire with a stamped addressed return envelope,

or two slightly different versions of a postcard reminder with the questionnaire weblink and QR code bringing participants to the same link. We randomly selected 900 consenting UCAT registrants who had not completed a questionnaire after email and SMS reminders to be randomly assigned to receive one of three types of postal reminders. One third (300) were randomly selected to receive the paper questionnaire, one third to receive one version of the postcard and a third the other version of the postcard. Response rates were 9% for the paper questionnaire, 16% for postcard 1 and 16% for postcard 2. As such, the remaining non-respondents were sent a postcard reminder in September after email and text message reminders. In early October 2019, all non-respondents received a final email reminder that mentioned the UCAS application deadline of the 15 October 2019.

To improve response rates UKMACS employed the following methods[35]:

► Incentive: entry into a prize draw.
► Increases salience: the questionnaires were administered to those seriously considering applying.
► Pre-notification: UCAT registrants were asked for consent to be invited.
► Repeated contact using different modalities: reminders delivered as emails, SMS texts and postcards.
► Improved accessibility: reminders included direct links to the responsive design online questionnaire.

Wave 2 recruitment and data collection

All participants who had started the Wave 1 questionnaire were invited to complete an online Wave 2 questionnaire between 26 November 2019 and 15 January 2020, with two email and two text message reminders. Participants were not invited if they had previously requested their data be removed from the UKMACS database, had previously asked not to be contacted for further research, or had not consented to having their personal information retained by the research team or linked with other information for research purposes. Participants were asked to confirm their name, email, and telephone contact details to enable linking to other data.

Wave 3 (COVID-19) recruitment

In March 2020, UK schools were closed and A-level (and equivalent public examinations) were cancelled due to the COVID-19 outbreak in the UK. This was a major disruption for education and university admissions in the UK and particularly significant for the UKMACS cohort, as they were mostly in their final year of schooling and due to sit examinations in the summer of 2020. We therefore administered an additional unplanned UKMACS questionnaire to understand what medical applicants were experiencing in terms of education, their views on how grades would be awarded following examination cancellations and their views on how medical schools might respond with regard to admissions policies.

So, between 8 April 2020 and 22 April 2020, all UCAT 2019 registrants who had consented to be invited to take part in UKMACS (Wave 1 population), and any other UKMACS participants who had completed a Wave 1 and/or Wave 2 questionnaire were emailed an invitation to complete an online questionnaire, with two email and two text message reminders. Participants were not invited if they had previously requested their data be removed from the UKMACS database, had previously asked not to be contacted for further research, or had not consented to having their personal information retained by the research team or linked with other information for research purposes. See Woolf et al[36] for further details. Participants were asked to provide their name and contact details for potential follow-up and linking to other data.

Incentives

Participants who completed both Wave 1 and Wave 2 questionnaires were entered into a prize draw for Amazon vouchers, drawn in February 2020. There was no prize draw for the Wave 3 questionnaire.

Ethics and informed consent

Approval for the study was granted by the UCL Research Ethics Committee (Reference: 0511/014). For each Wave, all participants were given a study information sheet, completed a consent form, and confirmed that they met the study eligibility criteria before starting the questionnaire. The consent form included consent for their data to be linked with other information about them for the purposes of research. In addition, for Wave 1, participants were asked to consent to being invited to take part in in future research, to be entered into a prize draw and contacted if they won.

Data linkage and external datasources

Participants consented to linkage of their questionnaire data to administrative data for research purposes within the secure data environment UKMED. The flow of data and linkages are shown in figure 2. This data included information on their education (eg, aptitude test results, school examination grades and predicted grades, type of school attended, university applications, offers and acceptances) and their background (geographic area, parental education and job, eligibility for Free School Meals, information on student loans).

Wave 1 and Wave 2 data on consenting participants were uploaded to the UKMED, and linked to UCAT and UCAS data using the following variables: participant UCAT registration ID, HESA ID, full name, date of birth and gender. However, additional checks using email addresses and school postcode were required as a small number had registered with UCAT twice, some respondents had completed the questionnaire more than once, and many of those who responded through the open link did not provide a UCAT ID. Data linkage used a number of passes through the data to match individuals across datasets and eventually achieved a 98% linkage rate. This process involved matching the data in descending order of reliability: the first match required all relevant variables to
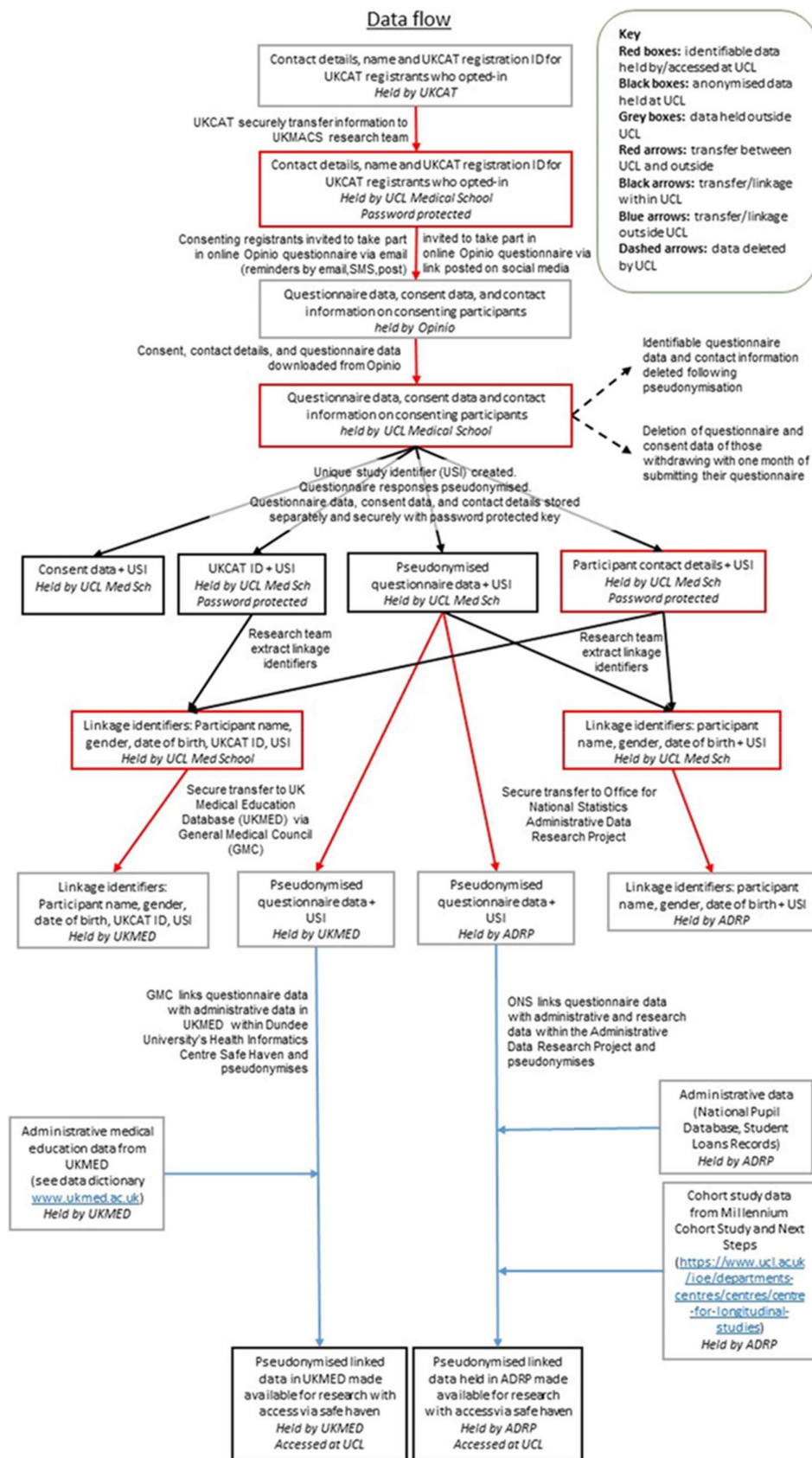
Data flow

Key
Red boxes: identifiable data held by/accessed at UCL
Black boxes: anonymised data held at UCL
Grey boxes: data held outside UCL
Red arrows: transfer between UCL and outside
Black arrows: transfer/linkage within UCL
Blue arrows: transfer/linkage outside UCL
Dashed arrows: data deleted by UCL

Contact details, name and UKCAT registration ID for UKCAT registrants who opted-in
Held by UKCAT

UKCAT securely transfer information to UKMACS research team

Contact details, name and UKCAT registration ID for UKCAT registrants who opted-in
Held by UCL Medical School
Password protected

Consenting registrants invited to take part in online Opinio questionnaire via email (reminders by email, SMS, post)

invited to take part in online Opinio questionnaire via link posted on social media

Questionnaire data, consent data, and contact information on consenting participants
held by Opinio

Consent, contact details, and questionnaire data downloaded from Opinio

Questionnaire data, consent data and contact information on consenting participants
held by UCL Medical School

Identifiable questionnaire data and contact information deleted following pseudonymisation

Deletion of questionnaire and consent data of those withdrawing with one month of submitting their questionnaire

Unique study identifier (USI) created. Questionnaire responses pseudonymised. Questionnaire data, consent data, and contact details stored separately and securely with password protected key

Consent data + USI
Held by UCL Med Sch

UKCAT ID + USI
Held by UCL Med Sch
Password protected

Pseudonymised questionnaire data + USI
Held by UCL Med Sch

Participant contact details + USI
Held by UCL Med Sch
Password protected

Research team extract linkage identifiers

Research team extract linkage identifiers

Linkage identifiers: Participant name, gender, date of birth, UKCAT ID, USI
Held by UCL Med School

Linkage identifiers: participant name, gender, date of birth + USI
Held by UCL Med Sch

Secure transfer to UK Medical Education Database (UKMED) via General Medical Council (GMC)

Secure transfer to Office for National Statistics Administrative Data Research Project

Linkage identifiers: Participant name, gender, date of birth, UKCAT ID, USI
Held by UKMED

Pseudonymised questionnaire data + USI
Held by UKMED

Pseudonymised questionnaire data + USI
Held by ADRP

Linkage identifiers: participant name, gender, date of birth + USI
Held by ADRP

GMC links questionnaire data with administrative data in UKMED within Dundee University's Health Informatics Centre Safe Haven and pseudonymises

ONS links questionnaire data with administrative and research data within the Administrative Data Research Project and pseudonymises

Administrative data (National Pupil Database, Student Loans Records)
Held by ADRP

Administrative medical education data from UKMED (see data dictionary www.ukmed.ac.uk)
Held by UKMED

Cohort study data from Millennium Cohort Study and Next Steps (https://www.ucl.ac.uk/ioe/departments-centres/centres/centre-for-longitudinal-studies)
Held by ADRP

Pseudonymised linked data in UKMED made available for research with access via safe haven
Held by UKMED
Accessed at UCL

Pseudonymised linked data held in ADRP made available for research with access via safe haven
Held by ADRP
Accessed at UCL

Figure 2 Data flow and linkage. UCL, University College London; UKCAT, University Clinical Aptitude Test (formerly the UK Clinical Aptitude Test); UKMACS, UK Medical Applicant Cohort Study; UKMED, UK Medical Education Database. GMC, General Medical Council; ONS, Office for National Statistics; ADRP, Administrative Data Research Project.

match while the final match only required two variables to match and was manually reviewed. Overall, only 154 (2%) cases were unaccounted for within the data.

In addition to data routinely available within UKMED, we obtained information about participants' schools (average school achievement and school type) from the following publicly available sources: Department for Education Schools, pupils and their characteristics[37]; Directorate for Education Analytical Services Performance & Attainment Statistics Team ad hoc data request[38]; Northern Ireland Department for Education and Northern Ireland Statistics and Research Agency data request[39]; Welsh Government ad hoc data request.[40] These data were imported into UKMED and linked to the questionnaire data.

We also obtained publicly available information about each UK medical school, imported it into UKMED and linked it to the questionnaire data, using it to calculate two measures of prestige for each of the medical schools applicants were aware of, considering, and had applied to. From *The Guardian* newspaper university rankings in 2020 we obtained the mean UCAS tariff points for entrants. We also obtained university rankings from the *Times Higher Education* University Rankings (accessed June 2021).

Anonymised linked data were made available for analysis within UKMED via the Safe Haven at Dundee to the research team in the first instance. After this initial period the data will be made available to approved researchers who complete the UKMED application process successfully.

Study participants
Wave 1 participants
See figure 3 for a flowchart of responses to Wave 1. Twenty-nine thousand three hundred and fifty-seven UCAT registrants in 2019 were asked to consent to be invited to take part. Eighteen thousand four hundred and eighty (63%) consented and 18359 were invited (121 were missing correct contact information). Six thousand four hundred and sixty-five participants started the Wave 1 questionnaire, comprising a 30% response rate for those invited via UCAT (n=5449), plus an additional 1016
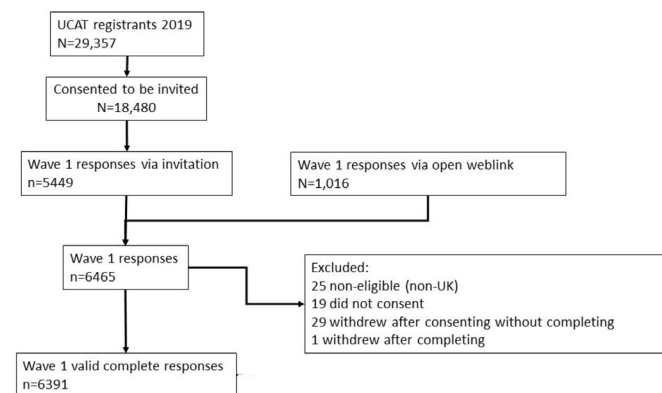
Figure 3 Flowchart of Wave 1 responses. UCAT, University Clinical Aptitude Test (formerly the UK Clinical Aptitude Test).

respondents who accessed the questionnaire through the open weblink. This accounts for approximately 36% of the 17540 UK domiciled applicants to Medicine in 2019 (a small proportion of Wave 1 participants did not end up applying by the October 2019 deadline to study medicine, meaning the percentage of UK domiciled medical applicants who completed UKMACS is actually slightly lower than 36%. [See (table 1) for demographic data on participants.] The exact proportion will be known once the questionnaire data are linked to UCAS) (https://www.ucas.com/data-and-analysis/undergraduate-statistics-and-reports/ucas-undergraduate-releases/applicant-releases-2020/2020-cycle-applicant-figures-15-october-deadline). Overall, we consider this to compare favourably with generally accepted response rates of 30% for online surveys.

To assess 'unit nonresponse' (an individual not participating in the survey) for any non-response bias, comparison was made between Wave 1 and respondents and those eligible and who consented to be invited but did not respond.[35] This was assessed via comparison of available demographic data. Gender data was available and showed that non-responders were approximately 60% women and 40% men, compared with 71% female respondents, indicating a small bias. Typically women are less likely to respond to initial contact but more likely to respond to repeated reminders[35] so this may be a result of the reminder strategy.

In terms of those excluded, 19 participants who completed a consent form did not agree to have their data analysed or linked; after consenting 29 participants withdrew from the study, (citing as reasons: not in the UK so realised not eligible; were only applying to dentistry not medicine so not eligible); one participant completed the questionnaire and then later withdrew consent and requested their information be removed.

Wave 2 participants
All Wave 1 participants with valid responses (n=6391) were invited to complete the Wave 2 questionnaire, and 2483 (38%) responded. Four withdrew, without citing reasons. Linkage to Wave 1 respondents and UKMED data identified 2448 participants. See figure 4.

Wave 3 participants
18480 consenting UCAT registrants plus the 1016 additional Wave 1 respondents who accessed the Wave 1 questionnaire via the open link were eligible to be invited to complete the Wave 3 (COVID-19) questionnaire; 3071 participants completed it, of whom 2904 stated they were eligible to take part.

After removing 16 respondents who did not consent to have their data analysed and 11 duplicates, there were 2877 valid cases for analysis, which is 15% of those invited. Of the 2877 responses to the Wave 3 questionnaire, we were able to identify 2704 in our database of those who had consented to the initial invitation to participate in the UKMACS study. One thousand four hundred and

Table 1 Reports the demographics for Waves 1, 2 and 3 participants.

	Wave 1, n (%)	Wave 2, n (%)	Wave 3, n (%)
Female	4509 (71)	1747 (71)	1968 (68)
Male	1852 (29)	686 (28)	749 (26)
Other/prefer not to say	30 (<1%)	15 (<1%)	20 (<1)
Missing			140 (5)
White	3030 (48)	1333 (55)	670 (23)
Asian	1994 (31)	662 (27)	301 (11)
Black	675 (11)	203 (8)	79 (3)
Mixed	311 (5)	127 (5)	63 (2)
Other	310 (5)	98 (4)	41 (1)
Missing/prefer not to say	71 (1)	25 (1)	1723 (60)
1+ parents in the highest socioeconomic group	4015 (63)	1575 (64)	1910 (66)
No parents in the highest socioeconomic group	2081 (33)	780 (32)	1742 (30)
Missing	295 (5)	93 (4)	116 (4)
No parent doctors	5635 (88)	2148 (88)	2408 (88)
1+ parents who are doctors	627 (10)	262 (11)	344 (13)
Missing	129 (4)	27 (1)	125 (4)
State school	3595 (56)	1698 (69)	783 (27)
Selective (grammar or private)	1606 (25)	358 (15)	785 (27)
Missing	1190 (19)	392 (16)	1309 (46)
IMD quintile 5 (most deprived—reverse scored)	1012 (16)	334 (16)	310 (11)
IMD quintile 4 (reverse scored)	1087 (17)	412 (19)	361 (13)
IMD quintile 3 (reverse scored)	1031 (16)	392 (18)	410 (14)
IMD quintile 2 (reverse scored)	1042 (16)	435 (20)	461 (16)
IMD quintile 1 (least deprived—reverse scored)	1331 (21)	584 (27)	704 (25)
Missing	886 (14)	291 (12)	631 (22)
In Year 13/S6	4160 (65)	1616 (66)	2212 (77)
One year post-year 13	692 (11)	192 (8)	179 (6)
Have/studying for a degree	1282 (20)	449 (18)	340 (12)
Other	257 (4)	10 (<1)	146 (5)
Missing	11 (0)	181 (7)	0 (0)
England	2003 (70)	1864 (76)	2003 (70)
Scotland	(6)	186 (8)	170 (6)
Wales	(3)	76 (3)	78 (3)
Northern Ireland/Forces/Islands	(2)	30 (1)	66 (2)
Other/missing	(20)	291 (12)	560 (20)
Total	(100)		(100)

IMD, index of multiple deprivation.

eighty-eight of these had also responded to the Wave 1 questionnaire and 949 participants had responded to all three questionnaires. See figure 5 for the flowchart of the COVID-19 Wave participants.

Variables

Variables from all three questionnaires are detailed in online supplemental files 3–5. For Wave 3, the questionnaire was suggested at the start of the first national lockdown in the UK due to the COVID-19 pandemic. It was therefore developed quickly and most items were designed specifically for this questionnaire to address

unprecedented events meaning validated items were not available. Other items were adapted from Wave 1 and Wave 2. Amendments to items were made in response to feedback from piloting with two current applicants and from the Medical Schools Council.

PRELIMINARY FINDINGS
Wave 1

For the initial analysis, a restricted sample of 2591 fully consenting respondents who were attending a UK school
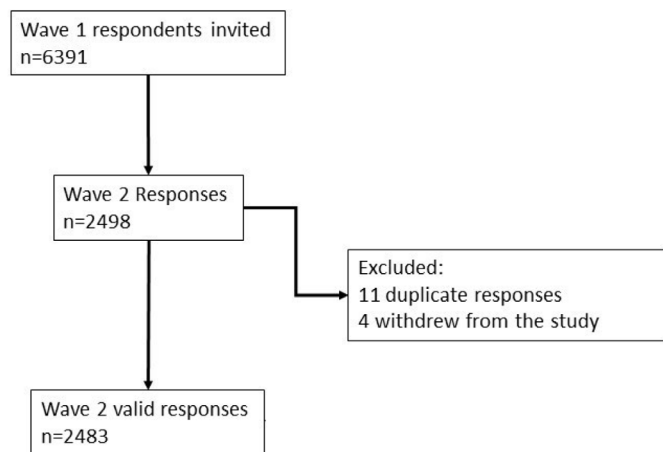
Figure 4 Flowchart of Wave 2 responses.

in their first year of post-compulsory education at the time of completing the questionnaire and were 18 years old by September 2020 were selected as this sample of respondents had the most complete data. Data was explored using descriptive statistics and univariate analyses in IBM SPSS for Windows V.26.

Three key outcome measures were size of awareness set, size of consideration set and prestige of consideration set. The key predictor variable was participant background, which we categorised into a 4-level variable (non-traditional, less traditional, more traditional, tradition) based on the number of the following binary indicators they had: individual-level indicator (at least one parent in the highest socioeconomic group=1 vs none=0), school-level indicator (privately funded school=1 vs state-funded=0) and area-level indicator (index of multiple
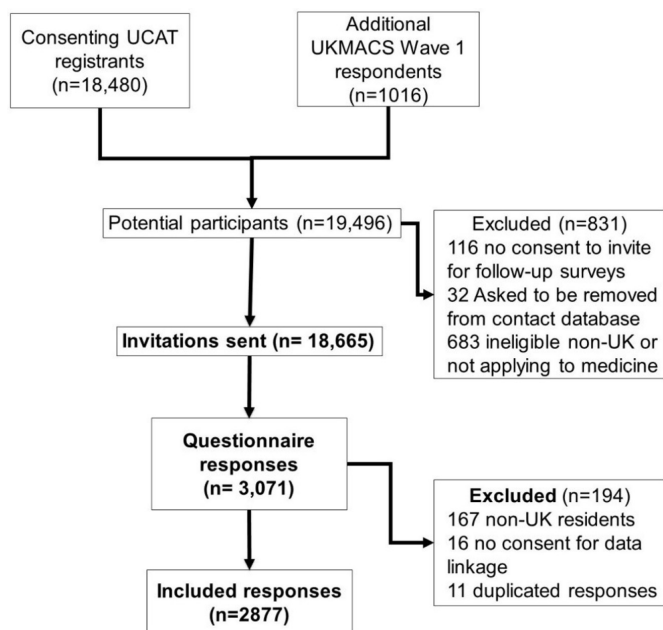
Figure 5 Flowchart of Wave 3 respondents. UCAT, University Clinical Aptitude Test (formerly the UK Clinical Aptitude Test); UKMACS, UK Medical Applicant Cohort Study.

deprivation quintiles 3 to 5=1 vs 1 or 2=0). The non-traditional group had no indicators, the less traditional group had one, the more traditional group had two, and the traditional group had all three.

Results[41] showed that participants from non-traditional backgrounds were aware of fewer medical schools than all other groups, even after considering other significant predictors including academic attainment, reasons for choosing a medical school, psychological capital, and information capital. There was no difference by background in the size of participants' consideration sets, but participants from traditional backgrounds were considering more prestigious medical schools on average.

Wave 2

Initial results[41] indicate that the majority (2108, 85%) of respondents had applied to medical school by the UCAS deadline. Of the 375 who did not apply, only 59 (2.4% of the respondents) no longer wanted to be doctors. Ninety had decided to apply to dentistry courses, other reasons for not applying were not achieving the admissions test scores (n=80) or A level grades (n=77) . Of those who did not apply, 116 were very likely and 72 quite likely to reapply in the future.

Most popular reasons for their first choice of medical school were: feeling confident they would meet the requirements, the medical school being close to home and offering the right teaching style for them. Interestingly, prestige was not in the four most common reasons for their first and second choices.

'Hot' sources of information[42] such as contact with other medical students (particularly via online) and up to date information from comparison websites such as the Medic Portal and Unifrog were considered by all groups to be the most helpful when it came to making choices about medical school.

Participants reported that the least challenging aspects of the medical school application process were meeting the early deadline for applications and getting support in their applications (very easy), and the most challenging aspects were getting the required grades, continuing to meet other commitments, obtaining work experience and preparing for interviews. Obtaining relevant work experience was seen as particularly different for 'non-traditional' applicants.

Wave 3

We aimed to describe the experiences and views of medical applicants from diverse social backgrounds following the closure of schools and universities and the cancellation of public examinations in the UK due to the COVID-19 pandemic. Key variables of interest were participant views on calculated grades (teacher-estimate grades that replaced A-level examination grades), views on medical school admissions and teaching in 2020 and 2021, and reported experiences of education during the national lockdown.

Results from Woolf *et al*[36] showed that participants, particularly female and ethnic minority participants, were concerned about calculated grades as these were generally not considered fair enough to be used by medical schools in the selection of offer-holders but were considered fair enough to use in combination with interview and aptitude test scores. Respondents from non-selective state schools also reported less access to educational resources compared with private/selective school pupils, less online teaching in real time, and less time studying during lockdown.

STRENGTHS AND LIMITATIONS
Strengths
These studies constitute the largest and most recent quantitative exploration of UK medical applicant views and experiences of applying to medical school, and form the baseline of an ongoing longitudinal study of the 2019 cohort, linked to prospective longitudinal administrative data within UKMED. Longitudinal cohort studies are well-placed to provide insights into how individual factors may influence choices, while also considering the influences of the institutional and social contexts of individuals. By including wide-ranging representation of different sociodemographic groups among these medical applicants and providing data on a range of academic, educational, psychological, social factors including those that predict medical school choice, admission and attainment and progression, UKMACS will allow for research on how medical selection shapes the medical workforce.

The value of large-scale longitudinal cohort studies to medical education was emphasised by the UK's 2014 Research Excellence Framework Education Panel who noted the 'few medical education equivalents to the [...] UK 1958 National Child Development Study or the 1970 British Cohort Study'.[43] Those 'few…equivalents' include the UK's two major longitudinal cohort studies of doctors: The UK Medical Careers Research Group studies and the McManus Cohort Studies.[44–46] Both have had a significant impact on workforce planning and on our understanding of doctors' behaviour and performance. However, they have not been able to answer questions about how current medical school selection and training impact on the medical workforce as they either do not study selection or, as with the McManus Cohort studies, have not studied selection since the early 1990s.

UKMACS addresses that gap by linking applicant data into UKMED allowing for longitudinal follow-up to study the impact of their choices on outcomes at medical school and beyond. Crucially, UKMACS includes data on unsuccessful as well as successful applicants the impact of selection on subsequent undergraduate and postgraduate outcomes of importance to be studied. It has also collected data from an understudied group – those who eventually decide not to apply to medical school,[47] potentially giving insights into those who could be doctors if only they had applied. Future analyses of the questionnaires

and linking to UCAS data will allow us to explore those who do not apply, defer application, and do not enter medical school and compare them with other applicants.

Weaknesses
The study primarily focuses on the 16–18 age group, a group notoriously difficult to engage.[48] There is a potential response bias since only 30% of those invited directly responded, with a further 6% responding via an open link and therefore from a less well-defined population. The 'true' denominator (those considering applying to medicine) is unmeasured, making it impossible at present to calculate the 'true' response rate. The typical first-time medical school applicants is a 17–18 year old with a record of high academic achievement. In 2019, 14 980 of the 17 470 UK-domiciled medicine applicants were first-time applicants.[13] Until the questionnaire data is linked with UCAS data (unavailable at the time of writing), it is unknown how many of the Wave 1 respondents applied in 2019, though using the Wave 2 responses as a guide it is estimated that approximately 30% of UK medical applicants had responded to the Wave 1 questionnaire. Comparing our cohort with UCAS demographic data on 2019 medical applicants shows a very similar profile for UK first-time Medicine applicants aged 17–19 in terms of ethnicity and areas of deprivation (see UCAS data releases www.ucas.com/data-and-analysis/undergraduate-statistics-and-reports/ucas-undergraduate-releases/applicant-releases-2019-cycle/2019-cycle-applicant-figures-15-october-deadline and www.ucat.ac.uk/media/1416/ucat-2019-technical-report-exec-summary_v1.pdf).

Completing the questionnaire may have raised participants' awareness of particular information sources, medical schools and course options or prompted consideration of other criteria. Given that it was probably impossible to minimise any such influence, participant information sheets and advertising stated that one potential benefit of taking part in the study was the opportunity to reflect on the application process. Waves 1 and 2 questionnaires were each administered over several months, and during each period it is likely that participants' attitudes and resources changed. Date of questionnaire completion is available to be included as a confounder variable in analyses of Wave 1 and Wave 2 data. While the questionnaires inevitably can only provide a snapshot of applicant views (which may change due to experiences after survey completion), the longitudinal nature of the study allows for follow-up of participants throughout their university careers and also to discover how the pandemic has impacted on them.

In terms of generalisability of findings to wider university applicant populations, medical school applicants are generally not representative in educational or sociodemographic terms of the average university applicant as school-leaver applicants to medical courses are predominately drawn from the more affluent postcodes, have parents in the higher SES groups and have attended a selective school compared with only 6.5% of children having an

independent sector education.[9] They also tend to have higher academic achievement. We are however able to make some cautious generalisations to other university applicants about factors influencing institutional choices, particularly in light of comparisons with other research in this area (see the next section).

Additionally, it is inevitable that there are questions about how representative the cohort is of medical school applicants. Initial comparisons with UCAS 2019 data on medical school applicants shows considerable similarity, though perhaps shows a higher proportion of non-traditional applicants. It must also be observed that the surveys are of those showing a serious interest in applying to Medicine in 2019 (primarily through the commitment of registering for admissions tests). As such, the cohort includes successful and unsuccessful applicants, those who chose to defer application and those who eventually decided not to apply at this time.

Comparisons with other research

The findings show many similarities to other studies of UK HE applicants, and studies outside of the UK,[11] however medical applicants have to go through a different application process to most other university applicants having earlier application deadlines, use of admissions tests and other pre-admission requirements. Comparisons with more general HEI and subject choice research[10 49 50] shows a similar focus on prestige or quality of university by more advantaged applicants and the greater priority given to location by more disadvantaged university applicants. Once UCAS data on successful applications to medical school has been linked in UKMED, the applicant profiles developed from Wave 1 and Wave 2 data can be used to extrapolate for the entire cohort and compared with previous cohorts.

Findings from the Wave 2 questionnaire on the usefulness of various information sources highlight the high importance all applicants give to 'hot' knowledge, and reflect the Wave 1 finding about the need for more help and guidance to make informed choices as opposed to requiring more information and findings from the wider literature that those from less advantaged groups report themselves as being at a disadvantage when applying[51 52] due to limited understanding of information and limited access to guidance to enable informed and effective decision-making.[53 54]

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