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Shaping the future medical workforce: take care with selection tools

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ABSTRACT

INTRODUCTION: Medical school selection is a first step in developing a general practice workforce.

AIM: To determine the relationship between medical school selection scores and intention to pursue a career in general practice.

METHODS: A longitudinal cohort study of students selected in 2006 and 2007 for The University of Auckland medical programme, who completed an exit survey on career intentions. Students are ranked for selection into year 2 of a six-year programme by combining grade point average from prior university achievement (60%), interview (25%) and Undergraduate Medicine and Health Sciences Admission Test (UMAT) scores (15%). The main outcome measure was level of interest in general practice at exit. Logistic regression assessed whether any demographic variables or admission scores predicted a 'strong' interest in general practice.

RESULTS: None of interview scores, grade point average, age, gender, or entry pathway predicted a 'strong' interest in general practice. Only UMAT scores differentiated between those with a 'strong' interest versus those with 'some' or 'no' interest, but in an inverse fashion. The best predictor of a 'strong' interest in general practice was a low UMAT score of between 45 and 55 on all three UMAT sections (OR 3.37, $p=0.020$). Yet, the academic scores at entry of students with these UMAT scores were not lower than those of their classmates.

DISCUSSION: Setting inappropriately high cut-points for medical school selection may exclude applicants with a propensity for general practice. These findings support the use of a wider lens through which to view medical school selection tools.

KEYWORDS: Cognitive tests; general practice; health workforce; medical student career choice; selection; UMAT

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Introduction

A strong primary care system helps meet the needs of people with chronic and multi-morbidities,¹ reduces inequities in health care delivery,² and is cost-effective.^{3,4} Medical schools have been challenged to be more socially accountable to their communities, including through production of graduates predisposed to enter primary care.^{5,6} Yet, in most developed countries, the proportion of medical students interested in general practice/primary care is declining.⁷⁻¹⁰ This contributes to workforce shortages, especially in regional and rural sites, and in poorer areas.¹¹

As most students admitted to medical school complete it, selection is a critical first step in the development of the future workforce. Interest in any career will be modified by medical school experiences, life circumstances, and incentives or disincentives in the health system that graduates enter. The literature suggests that factors that predict a general practice career include a desire for flexibility,¹² being from a minority group,² or coming from a rural area.¹¹ Additionally, attending a medical school that prioritises production of general practitioners (GPs) is important,^{13,14} although whether or not this is a student self-

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selection effect, or school effect, is uncertain. Nonetheless, there is a need to identify whether or not medical school selection processes help or hinder those who may be predisposed to a career in general practice.

In Australia and New Zealand (NZ), the Undergraduate Medicine and Health Sciences Admission Test (UMAT, Australian Council for Educational Research [ACER], Melbourne, Australia) has been introduced in the past decade as a selection tool for all undergraduate medical programmes. This general cognitive test is:

designed to assess general attributes and abilities gained through prior experience and learning; ... these abilities are considered important to the study, and later practice, of professions in the health sciences.¹⁵

The UMAT has three parts:

Section 1: Logical Reasoning and Problem Solving
Section 2: Understanding People
Section 3: Non-verbal Reasoning.

It has been estimated that 50% of the graduating class in NZ and the UK is needed in primary care. However, only a third of graduating students locally have a strong interest in working as a GP...

Examples of the multi-choice questions used are available in the UMAT Information Booklet on the UMAT website (<http://umat.acer.edu.au/>). Information on the same website shows UMAT was used by 14 medical programmes in Australasia in 2013. Universities use a variety of approaches for combining scores on general cognitive tests with measures of academic achievement and other tools, including weighting certain parts more highly, or using a cut-point. This is a score below which a student will not be selected. These may be pre-set, or determined by convenience, depending on the desired proportion of applicants to be selected.¹⁶

In the present study, we aimed to investigate whether there was an association between a

medical student's scores on selection tools, and a 'strong' interest in a GP career at exit from the programme. We were particularly interested in whether the new test, UMAT, might be helpful in choosing those predisposed to develop a strong interest in general practice by the end of their programme.

There were two main reasons for a specific focus on general practice. Firstly, this is the specialty with the greatest workforce needs;¹⁷ and secondly, there is insufficient student interest in this career. It has been estimated that 50% of the graduating class in NZ¹⁷ and the UK¹⁸ is needed in primary care. However, only a third of graduating students locally have a strong interest in working as a GP, which is similar to, or greater than the proportion seen elsewhere.^{9,18} Moreover, we have previously found levels of interest in a general practice career tend to drop over the course of the medical programme.⁹

Methods

Setting

The University of Auckland is one of two medical schools in New Zealand. Students enter year 2 of a six-year programme after a health sciences first year or prior degree. Ranking for admission is based on average UMAT score (15%), a 25-minute structured interview (25%), and grade point average (GPA, 60%) determined from prior university achievement. The University of Auckland does not use minimum cut-points in UMAT scores, and has a relatively low weighting of UMAT, allowing a wider range on which to determine the predictive validity. There are two affirmative pathways, one for Maori and Pacific students (MAPAS), and one for rural students. We have an ongoing programme of research to validate UMAT and the way it is used to make selection decisions.¹⁹

Since 2006, University of Auckland medical students have been invited to take part in the Faculty of Medical and Health Sciences Tracking Health Professional Students and Graduates Project (FMHS-TP). This is a longitudinal investigation of the characteristics and career patterns of students in the medicine, nursing, pharmacy and

health sciences programmes at The University of Auckland. The aim of the FMHS-TP is to evaluate the effect of curriculum and selection policies on the shape of the future health workforce. Students are invited to fill out surveys at entry and at exit from the programme, which include questions on demographics and career intentions, *inter alia*. Ethics approvals for both the UMAT Predictive Validity Study and the FMHS-TP were obtained from The University of Auckland Human Participants Ethics Committee.

Study design

The present study was a longitudinal cohort study of students entering The University of Auckland medical programme in 2006 or 2007, and progressing in sequential years to complete the programme in 2010 or 2011 respectively. We established a data set that linked student entry data from the UMAT study with corresponding exit data from the FMHS-TP, using student identification numbers. The relevant exit survey question was: 'For each of the following medical disciplines please rate your interest as a potential career.' General practice was one of a list of 18 disciplines for which respondents could tick 'strong', 'some', or 'no'.

Analysis

We performed a multiple logistic regression analysis, which found that none of gender, age, admission pathway (MAPAS, rural or gradu-

WHAT GAP THIS FILLS

What we already know: Medical student selection is a critical step in creating the future workforce. Worldwide, levels of interest in a general practice career are too low to meet health needs.

What this study adds: Lower scores on a widely-used general cognitive test were more predictive of interest in a GP career than any other admission variable. Care needs to be taken in setting the threshold cut-points for such tests, so as not to exclude those highly disposed to enter primary care.

ate) was significantly associated with a 'strong' interest in general practice. Hence, these variables were excluded from further analyses. Two-tailed *t* tests were used to identify whether students with a 'strong' interest in general practice scored differently to others on any of the selection tools (UMAT sections 1–3, GPA and interviews, see Table 1). Based on the results, we undertook an iterative process of identifying the range of UMAT scores that best distinguished between the students with 'strong' interest in general practice from the others, that is, would yield the highest odds ratio (OR) between the two binary variables: selection tool (1 = selection test score within the range; 0 = selection test score out of the range, whether smaller or larger); and interest (1 = strong interest, 2 = some or no interest). The iterative process consisted of splitting the data into two sets: one set included students with UMAT scores between any lower (L) and higher (H) value, and the second set included all other

Table 1. Comparison of selection tool scores between those with a 'strong' interest in general practice at exit from the medical programme and those with 'some' or 'no' interest*

Selection tool	'Strong' interest in general practice (n = 56) Mean (SD)	'Some' or 'no' interest in general practice (n = 99) Mean (SD)	p-value (t test)
GPA (range 1–9)	7.86 (1.46)	8.05 (1.00)	0.332
UMAT section 1	53.82 (8.37)	59.05 (8.44)	<0.001
UMAT section 2	52.68 (9.25)	56.34 (8.45)	0.013
UMAT section 3	57.07 (9.25)	56.07 (9.08)	0.513
UMAT average score	54.52 (6.72)	57.14 (6.10)	0.014
Interview (range 0–10)*	7.91 (2.09)	7.88 (1.73)	0.911

GPA Grade point average

UMAT Undergraduate Medicine and Health Sciences Admission Test

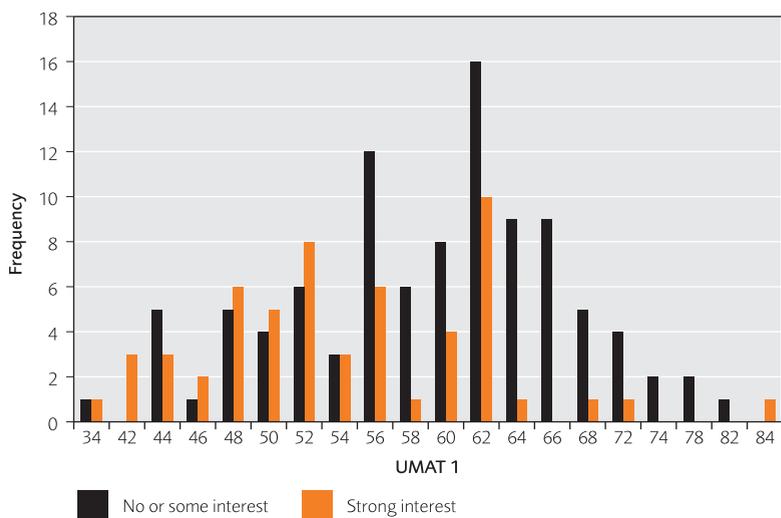
* Scores not available for Maori and Pacific students

Figure 1. The UMAT ranges tested were every possible combination of L and H, where L is a lower score and H a higher score



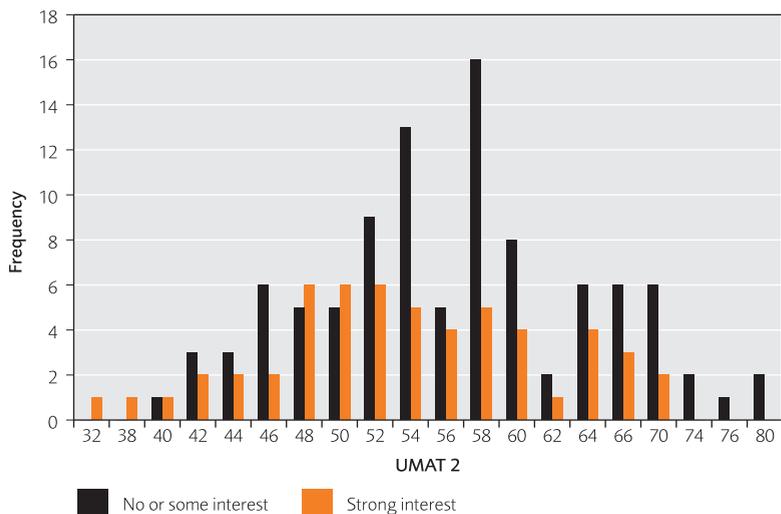
UMAT Undergraduate Medicine and Health Sciences Admission Test

Figure 2. Distribution of UMAT Section 1 scores by level of interest in general practice (numbers of students)



UMAT Undergraduate Medicine and Health Sciences Admission Test

Figure 3. Distribution of UMAT Section 2 scores by level of interest in general practice (numbers of students)



UMAT Undergraduate Medicine and Health Sciences Admission Test

students. We calculated the Odds Ratio for level of interest ('strong' vs 'some' or 'no' interest) for every possible combination of L and H where $Min < L < H < Max$ for each UMAT section and the average UMAT score (see Figure 1).

As universities may use the UMAT scores in varying ways, we tested two models: a compensatory model that uses the average UMAT score (high score on one section could compensate for low score on another) and a non-compensatory model, where scores on all sections must be within the defined range. We found moderate internal reliability among the three UMAT section scores, with a Cronbach's alpha of 0.55, which on the one hand indicates that each section is a discrete factor, but on the other, that all sections are somewhat related to each other.

Results

There were 260 students in the entry cohorts with UMAT scores available (international students do not sit the UMAT). We obtained corresponding exit survey data on 155 students. Completion rates for exit surveys are historically between 80 and 90%. That plus attrition or delayed progress through the programme accounts for the difference in the entry and exit numbers. Of those with paired data (n=155), 56 (36%) had a 'strong' interest in general practice at exit, with 99 (64%) expressing 'some' or 'no' interest. Those with a 'strong' interest had significantly lower scores on UMAT Sections 1 and 2 (and average UMAT score), but not on UMAT Section 3, GPA or interview. The Mean (SD) scores on selection tools for the two groups are shown in Table 1.

When these selection tool scores were included in a multiple logistic regression analysis, a 'strong' interest in general practice was associated with significantly lower scores on UMAT 1 ($p=0.022$), and possibly UMAT 2 ($p=0.053$). Since the score distributions of GPA and interviews were similar across interest levels, there was no further analysis of these variables. As UMAT Section 1 and 2 scores were more predictive than scores on other tools of a 'strong' interest in general practice, we looked more closely at the distribution of these scores (see Figures 2 and 3). Visually, most of those with a 'strong' interest in

Table 2. Preferences of students with UMAT scores between 45 and 55

	'Strong' interest in general practice (n)	'Some' or 'no' interest in general practice (n)	Chi-square	Odds Ratio
Average UMAT score in 45–55 range				
Yes	31	32	p=0.005	2.596
No	25	67		
Each of UMAT sections 1, 2, and 3 in 45–55 range				
Yes	10	6	p=0.020	3.37
No	46	93		

UMAT Undergraduate Medicine and Health Sciences Admission Test

general practice had UMAT scores between 45 and 55 inclusive.

Thus, we proceeded to examine the preferences of students with UMAT scores between 45 and 55. Whether the mean UMAT score was between 45 and 55, or scores from all three sections were in the range from 45 to 55, students with lower UMAT scores were more likely to have a 'strong' interest in general practice at exit (see Table 2). The strongest prediction was achieved when the admission score range was 45–55 inclusive in all three UMAT sections (OR 3.37, $p=0.020$).

Furthermore, the 16 students with scores of 45–55 on all three UMAT sections did not have significantly lower academic scores than the other students (7.81 vs 8.00, $p=0.548$).

Discussion

We had set out to determine whether or not selection tools, including UMAT, had any utility in identifying those students who at exit would have a 'strong' interest in a career in general practice. We did find an association; in fact, among the pragmatic variables we measured, UMAT scores were the only factors that differentiated between those with a 'strong' interest at exit in a general practice career versus those with 'some' or 'no' interest. To our surprise, the best predictor of a subsequent 'strong' interest in a general practice career was a relatively low UMAT score of between 45 and 55 on all three UMAT sections. There were 16 students with this configuration, and they were over three times more likely to have a 'strong' interest in a GP career than their class-

mates. On the other hand, it was reassuring that their GPA scores at entry were not significantly lower than those of their classmates, and that they had progressed through the medical programme in minimum time. In this study, none of interview scores, GPA, age, gender or entry pathway (graduate, indigenous, or rural origin) predicted a 'strong' interest in a general practice career.

Our findings raise two interesting points with respect to the use of general cognitive tests in medical school selection. The first is that there needs to be caution in establishing cut-points. Our example suggests that setting the cut-point too high on a general cognitive test may reduce the pool of students with a higher likelihood of entering priority careers, such as general practice. If The University of Auckland had, for example, set an arbitrary UMAT cut-point of 50, this would have reduced the pool of those with a 'strong' interest in general practice by over 10%. Our findings are supported by other evidence. In one of the longest predictive validity studies to date, McManus and colleagues²⁰ compared predictive ability of A-level results and the AH5 group test of intelligence (AH5) on medical career outcomes 20 years later. The AH5 is a timed test with two parts—verbal and reasoning, plus spatial ability, which has some similarity to the UMAT. Eventual hospital doctors had significantly higher scores on the AH5 than general practitioners ($p=0.040$), but this was not associated with differences in eventual career outcomes, such as career progression or achievement.²⁰

The second is a more problematic point that needs further study. UMAT scores are based upon

a test that has three sections: Section 1, Logical Reasoning and Problem Solving; Section 2, Understanding People; and Section 3, Non-verbal Reasoning.¹⁵ It is difficult to postulate why low scores on Section 1 and 2 were associated with a 'strong' interest in a general practice career, and scores between 45 and 55 on all three sections had the highest predictive ability of all. While it could be argued that the small numbers in this study may have led to sampling bias, and that the outcome of career intention at exit may not represent eventual practice, the findings further call into question what UMAT actually measures. Previously, we have found UMAT to have relatively small predictive ability compared to GPA on academic performance early in medical school, but both UMAT and GPA to have low predictive ability later in the programme.¹⁹ UMAT neither predicts drop-out from medical school,²¹ nor emotional intelligence on a standard test in final year medical students.²² Furthermore, using an aptitude test in the selection battery does not alter gender balance or ethnicity of students in an Australian undergraduate medical degree course.²³

All the students in this study completed their medical programme in a timely fashion, including a few with UMAT scores in the 30s. To determine the predictive validity of very low UMAT scores will be difficult given that in other schools these students may not be selected, because of exclusion by use of cut-points, or the negative impact of a low UMAT score on the total score for ranking. This may require collaboration among schools that do admit students with lower UMAT scores, or studies of outcomes of affirmative entry pathway students, where competition for places may not be so intense.

It is difficult to see how low scores on the UMAT may be used positively in selection decisions. However, this comment is based on the underlying assumption, seen in much of the literature, of a monotonous association between the scores on selection tools and the desirable outcomes; that is, the higher the selection test score, the better the outcome. This study has demonstrated that a non-monotonous association may provide another solution. This change in approach may be helpful in research, particularly,

yet not necessarily, when the desirable outcome is categorical, such as completion/non-completion of the programme or entry/non-entry into a priority career. It may also be useful in development of new selection tools or methods for use.

Our study raises the prospect of using UMAT scores differently in various groups of applicants, so as to form entry cohorts with the requisite aptitude to fill the future workforce. For example, should students in affirmative pathways have to sit the UMAT at all? One goal of these pathways is to offer places to those who might not otherwise succeed in a highly competitive selection process; a second is to diversify the student cohort so as to better meet future health needs. Further, once other tracking studies, such as the Medical Schools Outcome Database (MSOD) project,²⁴ provide more information on those with greater disposition to become GPs, would these students be candidates for a preferential pathway?

We have not yet looked at the relationship between the UMAT and career choice in other disciplines, but plan to do so. General practice is the first one studied as it is such a priority workforce, yet vulnerable through relatively low levels of student interest. In contrast, medical and surgical specialties are oversubscribed, so it would not matter if an arbitrary selection tool cut-point reduced the numbers with interest by a few. Other priority workforce areas in NZ are psychiatry and pathology, but the numbers involved are much smaller.²⁵

Limitations

Our study measured career intentions at the end of medical school, with students able to indicate 'strong' preferences in other specialties as well as general practice. We have previously found that general practice is the second most common 'strong' preference after medical specialties, with students still expressing an average of three 'strong' preferences at exit.⁹ The FMHS-TP is yet to validate to what extent a 'strong' preference in any discipline translates into a career choice. Nonetheless, in a British study, over 80% of graduates who indicated a first preference for general practice in the first year out of medical school were in this career 10 years on, with this

significantly higher than the match between intention and career for other disciplines.²⁶ Furthermore, we chose to use exit data in this study as it is more predictive of ultimate workforce choices than a choice at entry, as general practice career intentions change.^{9,27}

Our sample size is relatively small, and not all eligible students completed exit questionnaires. This may lead to Type 1 or Type 2 errors, but we have no reason to believe that the results are significantly biased, especially given the unanticipated findings. Despite the limitations, we believe this study has a broader message as stated in the conclusions.

Conclusions

General cognitive tests, such as the UMAT, have a face validity, reliability, low cost and convenience for schools that make them useful in differentiating among comparable students in order to offer the scarce number of places available. Our study provides a note of caution in how such tests are used; in particular, in how cut-points are set. At the very least, medical school selection policy must not lessen the chance of obtaining a pool of students with a 'strong' interest in a priority career, such as general practice. Our example supports the call to move the selection debate beyond psychometric properties of tools and subsequent academic achievement,²⁸ to one that focuses on better ways to select a student body that will develop into a medical workforce fit for purpose to meet the health outcomes of the entire community.

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COMPETING INTERESTS

None declared.