Exploration of medical students' approach to progress test preparation

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Abstract

Introduction: Medical students are expected to develop competencies in applying clinical knowledge. Progress testing is an assessment for learning and is intended to assist in knowledge acquisition and to promote ongoing recall. This study explored student preparation for progress tests (PTs), relationships between approach and performance, and patterns that could assist with targeting learning support.

Methods: A cross-sectional survey exploring study approach and learning context, comprising multi-choice and open-ended responses, was administered to students during their clinical years (n = 297). Quantitative data was analysed using descriptive statistics and comparative analysis, and qualitative data was categorised.

Results: One hundred twenty-nine students responded (43.4%), with most demonstrating a stable PT performance over time. Twenty-two students had dynamic changes in their aggregate grades. Poor early PT performance was associated with developing an improvement strategy (χ^2 6.954, p = 0.008). Students never falling below satisfactory were less likely to have a strategy (χ^2 10.084, p = 0.001). All poorly performing students were using practice question banks, but this was not true for students who scored satisfactorily. The need for pastoral care was associated with poorer performance (χ^2 4.701, p = 0.030).

Conclusions: Student approaches to PT preparation are diverse, however there are correlations between preparation factors and performance outcomes. Students with poor early performance demonstrated improved results over time that may be attributed to targeted support and preparation strategies. Widespread use of practice questions may not be sufficient to impact results without additional strategies. External impacts to performance were common, and barriers to accessing pastoral care were evident. The feedback dashboard was underutilised, suggesting a need to improve feedback literacy and ensure this is fit for purpose.

Keywords: medical students; study behaviour; progress tests; remediation; feedback

Introduction

Medical students are expected to achieve competencies across a range of curricular domains (Englander et al., 2013). These include medical knowledge, patient care,

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communication, professionalism and practice-based learning (Epstein, 2007). Developing effective approaches to acquire, expand and pass on knowledge is an essential lifelong competency for every doctor (Franz et al., 2022; Holmboe et al., 2017; Liles et al., 2018).

Progress tests (PTs) are one method of assessing applied knowledge longitudinally and were established at the University of Auckland (UoA) in 2013 (Lillis et al., 2014). These replaced high-stakes, end-of-year written examinations. Theoretically, PTs limit students' ability to prepare for a specific test. Rather, planned approaches to developing, refreshing and embedding knowledge are required for success (van der Vleuten et al., 2018). Analysis of PT data demonstrates longitudinal knowledge growth as well as increased ability to apply that knowledge to clinical problems (Cecilio-Fernandes et al., 2016; Gorlich & Friederichs, 2021; van der Vleuten et al., 2018). There are myriad factors that influence student preparation for PTs. For example, Wade et al. (2012) compared student preparation at two different medical schools and found that students from a medical school with later clinical contact were more likely to prepare last minute, to prepare less overall and to feel that preparation was less important.

After the PT, students in our institution who score non-passing aggregate grades are automatically allocated a clinical medical education fellow. Their dedicated role is to provide broad, academic remediation support for students. Detailed feedback is also provided to learners via an electronic dashboard, although to what extent students find this helpful is unknown. Ryan et al. (2017) explored how progress test feedback delivery can impact performance. They found that students' responses to written feedback can be influenced by the type of feedback provided and the students' relative position within their learning cohort. For example, they found that feedback containing normative comparisons resulted in inferior test performance for students in the lowest performing quartile. This group, in particular, spent more time engaging in generalised study and less strategic and content-specific study. A recent scoping review underlines the impact of PTs on knowledge growth and shifts in approach to learning but also identifies student dissatisfaction with feedback offered. Students sought feedback that was sufficiently personalised, detailed, focused and timely (Dion et al., 2022). This feedback ultimately influenced their perception and appreciation of progress tests.

The objective of our study was to explore how students prepare for PTs and provide insights into study habits, preferred study resources as well as barriers that influence PT preparation. Students' engagement with provided feedback was also of interest in light of the above.

Our primary research questions were:

1. How, when and what do students study in preparation for the progress tests?
2. Is there a relationship between approach to study and performance?
3. Are there any patterns that could assist the medical program to improve feedback and targeted support for students?

Methods

Design

A cross-sectional survey exploring study approach and learning context, comprising multi-choice and open-ended responses, was administered to clinical medical students (n = 297), those enrolled in Years 4–6, in June 2020. Quantitative data was analysed using descriptive statistics and comparative analysis, and qualitative data was categorised.

Setting and participants

The Auckland medical program is a 6-year program with entry via two different pathways—either Year 2 from a common health science course ("first year") or via graduate entry. Years 2–3 are primarily campus-based and cover foundational content. Years 4–6 involve placements within eight geographical clinical cohorts. Students attached to two larger sites were selected to provide a representative sample. One of the selected sites [A] was metropolitan (Auckland area) and the other [B] was a large regional clinical site including urban, suburban and rural placements.

Students are assessed using a variety of methods, one of which is a whole-program PT administered tri-annually to all enrolled students, with 125 single best answer items (one from five possible responses, plus "don't know"). Formula scoring allows for correct answers to be awarded one point, "don't know" to be awarded no points and a quarter of a point deducted for incorrect answers. Students receive a grade for each PT and an aggregate grade at the end of each year determined by a rubric. Students receive aggregates of unsatisfactory (U), borderline (B) or satisfactory (S), with the highest performing 10% of students awarded distinction (D). Students who receive a U or B grade are allocated a clinical medical education fellow (CMEF) to provide individualised learning support.

Upon publication of results, each student can use their university login to access the dashboard, providing feedback on individual performance. Students have access to both high-level overviews of cohort performance and grade boundaries, as well as fine detail on their answers, learning points and associated resources for each question.

Materials and procedure

A survey was constructed in Qualtrics (Provo, UT, 2020) and delivered anonymously online (Appendix 1). The survey consisted of a mix of multi-choice and open-text responses, covering demographics, progress test aggregate scores, dashboard use, approaches to study, resource preferences and a brief social and academic context. The survey link was sent via email, with one reminder. Data was exported to Excel for data cleaning. Cleaned data was imported into SPSS (v28, IBM Corporation 2021) for analysis.

Ethical approval was given by the University of Auckland Human Participants Ethics Committee (#2506).

Data analysis

When analysing impact on study preparation and strategies for improvement, free text was independently reviewed by multiple authors (MC, SK, SG and GS) and formed into categories with mutual agreement. Descriptive and frequency data was produced and categorised.

Comparative analysis was performed to explore relationships between different factors and aspects of PT performance. These were initially performed using chi-squared tests, however the overall dataset size and subcategories meant that cells frequently had zero to five data points. Thus, further data merging was needed to meet the requirements of the test. To optimise sample size, two binary performance variables were constructed as comparators:

1. Students were grouped as either having received an unsatisfactory (U) or borderline (B) aggregate at least once or having never received anything other than satisfactory (S) or distinction (D)
2. For each program year, students were identified as having received either a (U) or (B) aggregate score or having received an (S) or (D) aggregate score.

Qualitative free text was not subject to a qualitative method but was sorted and categorised.

Results

One hundred and twenty-nine students responded to the survey, with an overall response rate of 43.4% (129/297). Of all respondents, 88 students were from Clinical Site A (68.2%), while 41 students were from Clinical Site B (31.8 %). Representations of eligible populations were similar between the sites (51.5% vs. 48.5%), and demographic data was comparable (Table 1).

Table 1

Demographics of Eligible and Responding Students

		Eligible Population (n = 297)*		**Survey Respondents** (n = 129)*	
		Individuals	Proportion (%)	Individuals	Proportion (%)
Cohort	Clinical Site A	153	51.5	88	68.2
	Clinical Site B	144	48.5	41	31.8
Year of study (n = 128)	Year 4	105	35.3	47	36.7
	Year 5	106	35.7	44	34.4
	Year 6	86	29.0	37	28.7

		Eligible Population (n = 297)*		Survey Respondents (n = 129)*	
Gender	Male	124	41.8	41	31.8
	Female	173	58.2	88	68.2
Age	≤ 24	-	-	97	75.2
	25+	-	-	32	24.8
Ethnicity	NZ European	76	26.1	33	25.6
	Māori	44	15.1	21	16.3
	Pacific	18	6.2	7	5.4
	Asian	131	45.0	48	37.2
	ME/LA/African	22	7.6	3	2.3
	Other	6	NA	17	13.2
Entry program	First year	227	76.4	96	75.0
	Graduate	70	23.6	32	25.0
Entry pathway	General (incl. UTAS)	165	55.6	80	62.5
	MAPAS	56	18.9	26	20.3
	RRAS	39	13.1	11	8.6
	International	34	11.4	11	8.6
Domicile	Domestic	263	88.6	117	91.4
	International	34	11.4	11	8.6

* some missing data

Notes: ME = Middle Eastern, LA = Latin American, UTAS = Undergraduate Targeted Admission Schemes, MAPAS = Māori and Pacific Admission Scheme, RRAS = Regional Rural Admission Scheme

Progress test results

Students were asked to self-report their aggregate grades for each completed year (Table 2). There were a higher number of total responses for the Year 2 and Year 3 aggregates compared to later years, highlighting that some respondents were still completing Years 4 and 5 and, hence, would not yet have received an aggregate grade for these years. Each student's aggregate grade was plotted over time. For each student, performance over time was then coded into one of three categories: stable (no change in aggregate grade), improvement (most recent aggregate grade better than previous grade or sustained increase) or deterioration (most recent grade worse than previous grade).

Table 2

*Aggregate Grade by Program Year**

Program Year	U/B aggregates	S/D aggregates	Total
Year 2	4	116	120
Year 3	12	108	120
Year 4	4	72	76
Year 5	1	33	34

* Data available for 120/129 students

A stable aggregate was the most common finding (n = 99/120, 82.5%). For 11 (9.2%) students, their performance improved, and for 10 (8.3%), it deteriorated. As noted in the data analysis section, two new variables were derived to reflect student performance. For the second derived variable, 19 students had received an unsatisfactory or borderline grade at least once previously, and 101 students had never received either.

Study behaviours and resources

When asked about having a strategy for improvement, 49/120 (38.0%) indicated "yes", and 23/120 (17.8%) answered "maybe". Students were asked to describe what strategies they were utilising, and the following were identified: question banks; clinical attachments (*active*—patient-centred learning—and *passive*—observation/participation in clinical attachments); self-directed learning, textbooks or multimedia review; reflection and review of previous PT performance; and group study. Regular use of an MCQ question bank was reported by 97/112 (86.6%) students. Only five students used practice questions provided by the program.

Feedback dashboard responses are summarised in Figure 1. An overwhelming majority (111/118, 94.1%) "always" or "frequently" used the boundary graph function to view their individual and cohort performance. A majority "always" or "frequently" viewed their individual responses and blueprint breakdown (81.4% and 60.2%, respectively). The portal resources linked to the learning points were never or infrequently accessed by 87.3% of students.

When asked about an average university week, most respondents did report regular background study (87.0%). Students were also asked how much time was spent on specific study for progress tests in the weeks leading up to the assessment. By 2 weeks out, 91/115 (79.1%) students were doing targeted study for the progress test. Of the seven students who were not studying in the week before a test, six never studied for the PT and one started in the preceding 3 weeks. All had stable satisfactory aggregates.

Figure 1

Student Access of the Progress Test Feedback Dashboard

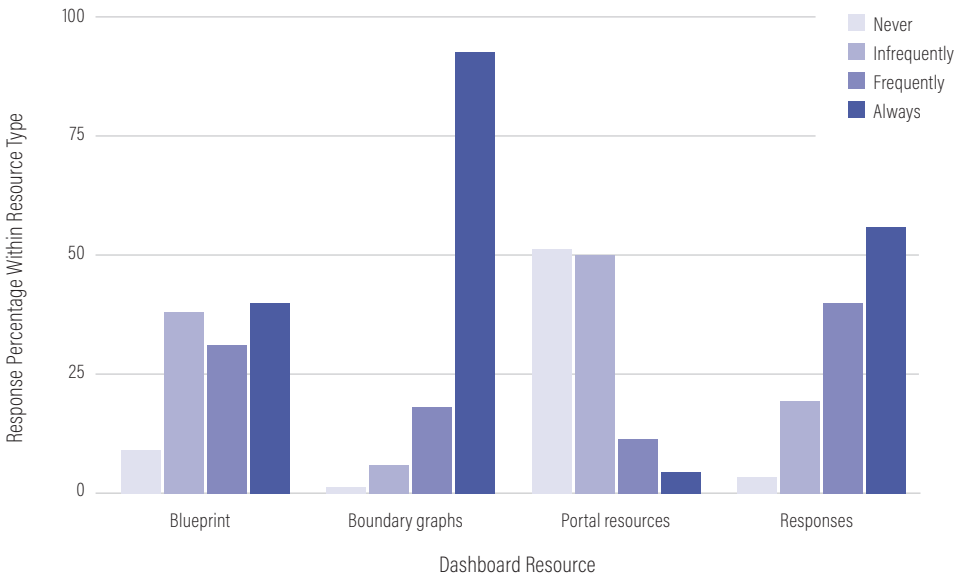
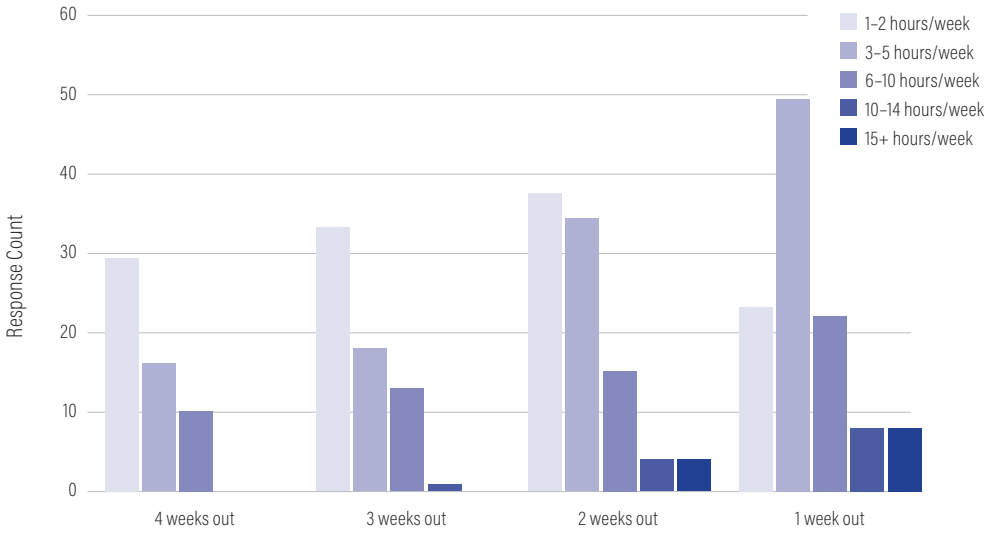


Figure 2

Summary of Hours per Week Studied Approaching Progress Tests



Of the participants, 96/112 (85.7%) indicated that they had a suitable study space. When asked to give a preference, 82 (73.2%) preferred their home environment, and 30 (26.8%) preferred another location or combination of places to study—library, hospital, Māori and Pacific Admission Scheme (MAPAS) house, cafes. A small number of students did not have a suitable quiet and private study space. For the unsatisfactory/borderline (U/B) group, this was 3/16 (18.8%) and for the satisfactory/distinction (S/D) group 13/96 (13.5%). Three quarters of students (85/112, 75.9%) preferred to study alone, and the remainder (27/112, 24.1%) preferred to study as part of a group.

Students were asked to identify the settings or resources that they found helpful for learning. Counts for each setting and/or resource were tallied, and the final ranking was: 1) clinical attachments, 2) bedside teaching, 3) online written resources, 4) online video, 5) lectures and 6) textbooks. Students were then asked to specify resources or approaches they found most helpful. Some of the commonly mentioned examples are summarised in Table 3.

Table 3

Examples of Resources Students Used to Improve Their Medical Knowledge

Question banks	Passmedicine
	BMJ Best Practice
Online knowledge resources	Best Practice Advocacy Centre New Zealand (BPAC NZ)
	BMJ Best Practice
	AMBOSS
	UptoDate
	Regional HealthPathways
Textbooks	Talley and O'Connor's Clinical Examination
	Oxford Handbook of Clinical Medicine
Online video/multimedia	Osmosis (Elsevier)

Impacts on study from external factors

Students were invited to provide context on external impacts to PT preparation and could list one or more reasons. Of the participants, 38.8% (n = 50/128) experienced events that had impacted their study. Examples included personal health (37; physical 18, mental 19), family/whānau/relationships (25), financial/employment (6), learning environment/hospital/placement issues (2) and extracurricular activities (1).

Pastoral care was received in some form by 11.6% (n = 15/128) of students. The most common providers of this were MAPAS, Director of Medical Student Affairs (DMSA)

and CMEFs. Other supports occasionally mentioned were counsellors, student support services, disability services, other academic staff members and/or external persons.

Of the participants, 26.4% (n = 34/128) were in paid work outside of the medical program. Seventeen (13.2%) of these worked less than 4 hours/week; 16 (12.5%) worked between 4–16 hours/week; and one worked more than 16 hours/week.

Comparative analysis

Improvement strategy by year

Comparative analysis was performed for aggregate grades and presence of improvement strategies, stratified by year group. For Year 3, students who had a U/B grade were significantly more likely to report having an improvement strategy, where students with a S/D in Year 3 were equally likely to report having or not having an improvement strategy [$\chi^2(1, n = 97) = 6.954$, $p = .008$]. This relationship was not found in other years.

Table 4 depicts all students who had a U/B aggregate at the end of Year 3 and their subsequent performance in all other completed years. All these students reported having an improvement strategy and did improve their aggregate grade.

Table 4

Year 3 Students With U/B Aggregate and Reported PT Performance in Following Years

Students*	Year 2 Aggregate	Year 3 Aggregate	Year 4 Aggregate	Year 5 Aggregate
A	U/B	U/B		
B	S/D	U/B		
C	S/D	U/B	U/B	S/D
D	S/D	U/B	S/D	
E	S/D	U/B		
F	S/D	U/B		
G	S/D	U/B	S/D	S/D
H	S/D	U/B		
I	S/D	U/B		
J		U/B	S/D	
K		U/B	S/D	S/D
L		U/B	S/D	

* Anonymised letter code

Improvement strategy by overall U/B and S/D group

Students who, at any point in their academic history, had achieved a U/B yearly aggregate were significantly more likely to report having a grade improvement strategy than not.

Conversely, students who had never scored below a satisfactory yearly aggregate were more likely to report not having an improvement strategy [$\chi^2(1, n = 120) = 10.084$, $p = .001$].

Pastoral care

Nineteen students reported receiving pastoral care at some stage. These students were more likely to be in the U/B than the S/D group (5/19 vs. 9/92) [$\chi^2(1, n = 120) = 4.701$, $p = .030$]. Students who received pastoral care were neither more nor less likely to have an improvement strategy [$\chi^2(1, n = 120) = 1.745$, $p = .187$].

MCQ bank use

Students in the U/B group were just as likely to be using an MCQ bank [$\chi^2(1, n = 112) = 2.887$, $p = 0.89$], but all 16 U/B students were using a bank compared with 81/96 (84.4%) of the other students.

Employment

Employed students were less likely to have had a U/B at some point [$\chi^2(1, n = 120) = 5.599$, $p = 0.018$]. There was a higher employment rate in those who had never had a U or B grade (32/69 vs. 1/19).

Mode of studying: Alone or in a group

Those who had received a U/B were more likely to be studying in a group [$\chi^2(1, n = 112) = 3.937$, $p = 0.047$]. Of students with a U/B, 43.8% (7/16) used a study group, whereas only 20.8% (20/96) of S/D students were part of a study group.

Non-significant comparisons

No significant relationship was found between performance variables and accessing any pertinent component of the dashboard. Therefore, underperforming students were not more likely to be using these resources. Self-identified impacts to study were not found to be significantly related to either performance variable. The two binary performance variables were also compared with demographic variables, number of study hours, study pattern, study space or study location. No significant findings were identified.

Discussion

This study sought to explore medical students' preparation for progress testing. We conducted post-hoc analysis comparing factors between students who had achieved passing grades (satisfactory/distinction) and students who had not (unsatisfactory/borderline). Most students had a stable aggregate grade, and a small proportion (9.2%) demonstrated improvements in their scores over time. This was despite 38% reporting an improvement strategy. Students who had previously achieved a U/B grade at some point in their academic history were more likely to have a strategy ($p = 0.001$), and this

was more marked for pre-clinical year groups. Our data shows that more students in this group improved their PT performance with time, and while speculative, institutional supports, such as mentoring provided by clinical medical education fellows, are likely to be a contributor. The authors considered the impact of the clinical medical education fellow to be independent of the strategies students were asked to identify, as these were more personalised plans for future learning. Conversely, students who had never scored below satisfactory were less likely to have a strategy for improvement ($p = 0.001$).

The most prevalent resource for PT preparation was practice question banks, with 86.6% of respondents reporting use of these. Question banks allow students to practise exam technique and engage active learning and cognitive recall processes (Wynter et al., 2019). Performance on question banks has been shown to correlate with academic performance (Clemency et al., 2017), however Ryan et al. (2017) found that lower quartile students were more likely to engage in generalised study, which might include practice questions. In our study, all students in the U/B group were using practice questions, and this was not the case for the S/D cohort. This may suggest that these resources alone are not sufficient to achieve passing grades. In our cohort, however, the overall use of question banks was high for all students. This is likely an observable pattern in many other educational centres with the modern proliferation of electronic learning resources (Wynter et al., 2019). Our study did not examine whether there was a temporal relationship between practice question use and achievement. Regardless, developing practice questions that align with university curricula and accurately reflect local contexts, practices and guidelines is an important consideration for all programs, acknowledging that this is a time and resource intensive process.

Most students performed targeted study for the PT in the immediate weeks approaching each test and increasingly so closer to the time of assessment, although this change was relatively small. This mirrors the suggestion that PTs encourage learners to use a blended approach of superficial and deep learning and that PTs may carry equivalent or reduced assessment-related stress to traditional assessments (Chen et al., 2015). At 2 weeks prior to the PT, most students (79.1%) were doing some regular study, however only a very small proportion (4.3%) were completing 10 or more hours per week (1–2 hours per day). This proportion remained small even 1 week prior to the PT (12.3%). This perhaps reflects a shift away from an intensive, cramming style of preparation to a more regular and frequent knowledge consolidation approach. In a different but related theme, students ranked knowledge gained from experiential learning, such as clinical attachments, as most valuable, above written or digital content. When interpreted together, these findings suggest that students value incremental, combined, active and passive learning over time. There is also potential for an unmeasured learning gain for those who did not perform any specific PT study but still achieved adequately. In the study by Wade et al. (2012), positive factors for learners' engagement with PT were concurrent clinical context, PTs functioning as the main knowledge assessment and a culture of continual deep self-

directed learning. Our findings support this, with the first two factors being fulfilled in our cohort.

However, we have recognised the need to improve our feedback literacy. In regards to feedback, most students reviewed their cohort scores (94.1%) and blueprints (60.2%), which were provided on the online dashboard, but only a small minority made use of the linked resources available (14.6%). Feedback literacy for staff and students is universally recognised as an important part of the assessment ecosystem. Molloy et al. (2020) describe a framework of seven groups, with examples including commitment, processing, acknowledging emotions and taking action. This study was not designed to explore the reasons for limited feedback utilisation, but speculation is possible. Firstly, it may be to do with *why* students believe they receive feedback following assessment. Preston et al. (2020) found that only a third of medical students believed assessments allowed them to recognise gaps in their learning, and only 13% felt it helped them to address these. Thus, students with passing aggregates may not have perceived any utility in reviewing their feedback if their knowledge was judged to be adequate. Second, it may be to do with *who* students feel is responsible for feedback. Molloy et al. (2020) discuss how students hold beliefs that feedback is a skill required by teachers and not learners. Consequently, students may be seeking assistance with interpretation of their PT feedback instead of reflecting on their results individually. Finally, students may not find benefit in *how* the feedback is delivered. Students may expect or desire open dialogue between teacher and student as opposed to unidirectional feedback via the dashboard as is currently delivered (Molloy et al., 2020). Support from fellows may have gone some way to address these issues in poorer performing students, but the medical program also needs to promote feedback literacy more widely, with clear opportunity for future research and improvement.

With respect to external impacts to PT preparation, over a third of respondents reported significant events during their studies (38.8%). Physical and mental health impacts were most prevalent. Globally, and locally, there is a high incidence of mental health issues amongst medical students (Puthran et al., 2016; Steiner-Hofbauer & Holzinger, 2020). This incidence increases as students progress through training (Dyrbye et al., 2005; Moir, Yielder, Sanson, & Chen, 2018). The burden of regular assessments, the competitive environment and motivation are some of the multiple factors that have been postulated to contribute (Hill et al., 2018). Interestingly, experience of these events was not found to be significantly correlated with performance. It seems likely in our cohort that these impacts were mitigated via a combination of individual and institutional factors. Institutional interventions available in our setting include resilience training, health and wellbeing practice, pastoral support and compassionate consideration processes (Moir, Yielder, Dixon, & Hawken, 2018). It was notable that students in the U/B cohort were significantly more likely to have received pastoral care compared with higher achieving matched controls ($p = 0.03$). From a broader perspective, however, significantly more students reported impacts to their PT preparation than ever received pastoral care support

(38.8% vs. 11.6%). This suggests that despite the improvements in support services, there appear to be persisting barriers to access and continued room for progress in this space.

Finally, with regard to study environments, 14.3% of students did not have access to a quiet and private study space. This affected a greater proportion of the U/B cohort than others (18.8% vs. 13.5%). The learning environment that students occupy has been implicated as a major factor contributing to assessment performance (Lizzio et al., 2002). Understanding the characteristics of these disadvantaged students and the specific barriers they face would be an important piece of future work to ensure equitable learning opportunities.

There are several strengths of this study. Whole-program, single best answer assessments are in widespread use around the world, and our insights are likely applicable to a broader medical education context (Dion et al., 2022). Comparative analysis of preparatory plans for students achieving differing grades has shown that a combination of cumulative, integrated study over time, rooted in clinical contexts, are most valued by students. The value of academic and pastoral support for struggling students is suggested by the data, and several targets for improvement have been identified.

There are also study limitations. Our response rate was 43.4%, and there was greater representation from Clinical Site A compared to B, which may have caused clustering effects. Collecting responses from more students would be desirable to capture greater numbers across the grade boundaries. Despite this, our study population was reflective of the broader medical student body. Grade data was recalled and self-reported rather than extracted from academic records, however we felt extraction from academic records may negatively affect student participation. The effect of inaccurately recalling grade data was felt to be partially mitigated, as students had the ability to access their complete historical performance record. Each PT result includes a numerical score as well as a grade (e.g., satisfactory or distinction), and using the numerical score would have allowed a finer analysis of improvement or deterioration in performance. Greater qualitative data collection in the study, such as focus groups or semi-structured interviews, may have provided further information to reinforce our findings.

Conclusion

Our study shows that there are correlations between how students prepare for progress tests and their performance outcomes. Students who performed poorly early in the program were targeted with supports and gained an improvement strategy, which generated better results over time. Widespread use of practice questions was common, but these were neither context specific nor observed to impact results without additional strategies. In contrast, learning associated with clinical attachments was highly valued. Most students performed regular background study as well as dedicated PT study, but short interval, intensive study was not an observed pattern. External impacts to performance were common, but not all students accessed institutional supports. Future

qualitative work could explore these findings in detail and better define specific action points. The disconnect between feedback and dashboard access suggests a need to improve feedback and ensure this is fit for purpose.

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