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ORIGINAL ARTICLE

Evaluation of the Prescribing Skills Assessment implementation, performance and medical student experience in Australia and New Zealand

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Aims: The UK Prescribing Safety Assessment was modified for use in Australia and New Zealand (ANZ) as the Prescribing Skills Assessment (PSA). We investigated the implementation, student performance and acceptability of the ANZ PSA for final-year medical students.

Methods: This study used a mixed-method approach involving student data ($n = 6440$) for 2017–2019 (PSA overall score and 8 domain subscores). Data were

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also aggregated by medical school and included student evaluation survey results. Quantitative data were analysed using descriptive and multivariate analyses. The pass rate was established by a modified Angoff method. Thematic analyses of open-ended survey comments were conducted.

Results: The average pass rate was slightly higher in 2017 (89%) which used a different examination to 2018 (85%) and 2019 (86%). Little difference was identified between schools for the PSA overall performance or domain subscores. There was low intercorrelation between subscores. Most students provided positive feedback about the PSA regarding the interface and clarity of questions, but an average of 35% reported insufficient time for completion. Further, 70% on average felt unprepared by their school curricula for the PSA, which is in part explained by the low prescribing experience; 69% reported completing ≤10 prescriptions during training.

Conclusion: The ANZ PSA was associated with high pass rates and acceptability, although student preparedness was highlighted as a concern for further investigation. We demonstrate how a collaboration of medical schools can adapt a medical education assessment resource (UK PSA) as a means for fulfilling an unmet need.

KEYWORDS
assessment, clinical pharmacology, education, error, medication safety, prescribing, undergraduate

1 | INTRODUCTION

The current World Health Organization Patient Safety Challenge *Medication Without Harm* identifies medication safety as an international priority.[1] The challenge aims to reduce iatrogenic medication related harm by 50% within 5 years. In Australia and New Zealand (ANZ), a key action in response to this challenge is to increase early career prescriber competency.[2] Measuring prescribing competency has many possible benefits: informing future medical practitioners of the necessary standards to be achieved; objective documentation of standards; informing medical schools of requirements for curriculum and teaching; creating efficiencies through consistent teaching and assessment on a national or regional level; and giving feedback on performance to medical schools and students.[3] Most importantly, rigorous assessment is required to provides confidence to medical students, healthcare providers and consumers that medical graduates can prescribe safely.

Prescribing is a complex and challenging task. There is ample evidence that undergraduate medical students do not feel confident in their prescribing[4] and many do not have adequate prescribing skills at the point of transition from medical school to clinical practice.[5,6] This is confounded by a lack of consensus from educators about what prescribing skills and competencies are necessary for practice.[4] In the complex, often highly pressured workplace with multiple competing demands, junior doctors are at risk of making medication errors.[7,8] While the consequences for patients from medication errors are recognized,[9] there are also negative consequences for the prescriber.[10,11]

What is already known about this subject

- The UK's Prescribing Safety Assessment (UK PSA), an online tool to assess the prescribing skills of candidates, was developed to gauge prescribing competence of medical students.
- The UK PSA has been in use in all UK medical schools since 2014, with reported pass rates exceeding 90% and positive student feedback.

What this study adds

- The UK PSA has been adapted and gradually taken up in New Zealand and Australia, with 13 medical schools and >5000 students participating in 2021.
- This study demonstrates that a medical education assessment developed in the UK can be adapted by other countries, through a collaboration of clinical pharmacologists, a wide range of medical practitioners, pharmacists and educationalists, with high pass rates and generally positive student experiences.
- This study highlights that further educational strategies are needed to prepare students more completely for prescribing in Australia and New Zealand.

After a period of development and pilot implementation by the British Pharmacological Society (BPS), the Prescribing Safety Assessment had its first national implementation across all UK medical schools in 2014.[12] This was introduced as a formative assessment. The pass rate was high (94%) and student feedback was positive.[12] With the move to a summative barrier assessment in 2016, the pass rate on the first attempt remained high (95%). A difference in performance between medical schools was noted, which has persisted over time, and may partly reflect differences in emphasis and training in clinical pharmacology across schools.[13]

Use of the Prescribing Safety Assessment has extended beyond UK medical graduates to at least 13 countries, each with at least 1 participating medical school, on 4 continents (personal communication, Alexandrea Cole, BPS Assessment Ltd, 2022). The assessment has been successfully modified for trial across 4 Canadian medical schools. While results from the first pilot indicated a skills deficit, with only 47.6% scoring above the passing threshold, the assessment content and structure was acceptable to students.[14] In contrast, Scottish pharmacist prescribers performed equally in the assessment when benchmarked against UK medical students. They found the online tool usable and acceptable and saw utility in use of the assessment at multiple time points in training.[15]

In Australia, *safe prescribing* is a national health priority and a competency framework has been developed for Australian prescribers.[2,16,17] Similarly in NZ, standards for *good prescribing practice* have been published by the Medical Council of New Zealand.[18] ANZ medical schools together with the Australasian Society of Clinical and Experimental Pharmacologists and Toxicologists (ASCEPT) collaborated with the BPS to adapt the PSA for Australasian students as a pilot initiative in 2015. The decision to initiate and continue using this assessment was based on several factors, including similarities in the medical school training and healthcare systems between ANZ and the UK, confirmation of its content validity by independent review, its high reliability of >.7[13] and the pragmatic use of an existing assessment. The assessment system name was changed from *Prescribing Safety Assessment* to *Prescribing Skills Assessment* in ANZ, while the abbreviation PSA is used interchangeably and will be referred to as the ANZ PSA in this article.

1.1 | Development of the ANZ PSA

The ANZ PSA[19] is an online teaching and assessment tool which provides resources, practice papers and a final assessment of safe prescribing for both adult and paediatric patient cases. Candidates prescribe, calculate doses, identify prescription issues, determine critical information to provide to patients, monitor effectiveness and adverse reactions of medications, and write prescriptions considering clinical and laboratory data.[19] Management planning cases include higher risk patients with comorbidities, renal and hepatic impairment and polypharmacy. Emphasis is placed on medications prone to prescribing errors and adverse events, such as analgesics, antimicrobials, anticoagulants, insulin and fluids.

Staff from all ANZ medical schools were invited to participate in the creation and standard setting of the ANZ PSA. This collaboration involved over 50 senior and junior staff across universities and clinical environments. There was a wide multidisciplinary representation (e.g., addiction medicine, anaesthetics, cardiology, clinical pharmacology, emergency medicine, endocrinology, general practice, geriatrics, intensive care, medical education, internal medicine, nephrology, neurology, oncology, paediatrics, pharmacy and rheumatology). Standard setting is done with the understanding that a given question may be repeated in a future exam and hence confidentiality of the questions regarding exposure to students is paramount.

Potential questions were made available from the BPS to ensure alignment. Approximately 15 ANZ content expert reviewers collaborated to regionalise questions and align with national formularies (Australian Medicines Handbook and New Zealand Formulary).

Training in the modified Angoff method[20] was conducted with the same content experts in 2017 and 2018 by videoconference. Best practice methods were used including detailed discussion of *just passing* students. After Round 1, outlying scores were debated on the *Basecamp* online platform, followed by submission of Round 2 scores, which generated a passing standard for each question. The passing standard for the whole exam comprised the sum of the passing standard for the questions in each domain.

The PSA was a restricted open book examination in that students had access only to their national formulary. After implementation, the BPS provided each school with each student's total score (200 marks) and 8 domain subscores: Prescription (80 marks), Prescription Review (32 marks), Planning Management (16 marks), Communication Information (12 marks), Calculation Skills (16 marks), Adverse Drug Reaction (16 marks), Drug Monitoring (16 marks) and Data Interpretation (12 marks). Students received a report on their performance in each area and whether they obtained the ANZ passing standard overall. Two papers were used over the 3 years, with the 2018 and 2019 ANZ PSA being the same. The passing standard was 56.5% for 2017 and 63.5% for 2018 and 2019.

This paper evaluates the ANZ PSA for the pre-COVID implementation of 2017–2019 for 3 research objectives:

1. To evaluate student performance on the ANZ PSA
2. To investigate the degree of variation in performance by school in the ANZ PSA
3. To evaluate the acceptability of the ANZ PSA for students

These research objectives address the equivalence, educational, catalytic effect and acceptability criteria outlined for medical education.[21] The remaining criteria of reliability and validity have been established elsewhere.[13] Data from 2015 and 2016 were excluded due to small numbers of schools participating. Data from 2020 and 2021 were excluded due to atypical implementation with limited invigilation due to pandemic restrictions. The 2018 ANZ PSA had internet connectivity issues affecting access to the online national formularies in both countries for mid-year implementations.

2 | METHODS

The first research objective, student performance, was assessed by student-based data for the total score and the 8 domain subscores provided by BPS in a fully deidentified file. Due to the BPS having contractual relationships with each school and in accordance with the Ethics covering this project, student-based data were deidentified by student and school. The 2018 and 2019 student data had an additional variable indicating the date of the assessment in the academic year, which ranged from February to December. This variable was classified into 3 time periods for the purpose of analysis: Early (February to July), Middle (August to October) or Late (November to December).

To address the second research objective, school-based results were obtained from an opt-in request to the medical schools that participated in the ANZ PSA in at least 1 of 2017, 2018 and 2019. The 2 senior authors (C.H.) and (D.O.M.) designed an online template that allowed each school to enter their aggregated data confidentially for the purposes of this research. For example, each school chose a confidential code for each year such as *A for 2017* and *G for 2018*. Due to the need for confidentiality, the number of years for which each medical school contributed their summary data is unknown. The summary statistics included the pass rate and aggregated school mean for the total score and the 8 domain subscores. The number of students associated with each of the school-based data sets was not collected to maintain school anonymity. Although most schools implemented the PSA formatively at the start of this project, whether it was formative or summative was not collected to protect anonymity.

The third research objective, regarding the acceptability of the ANZ PSA for students, was evaluated through the BPS opt-in anonymous student survey responses, which students were invited to complete at the end of each assessment sitting. The survey included both closed and open-ended questions (Table S1) and was reported to schools as aggregated tables, and hence these data were also collected using the confidential online template.

The 4 open-ended responses reflecting student experience were reviewed by a panel of 4 authors (B.M., D.R., D.J. and C.L.) and the responses for the 2 open-ended questions reflecting student preparedness and curriculum improvements were reviewed by 2 authors (K.C. and T.M.) to identify common themes. Categorization of responses was then carried out independently by the panel members, with inconsistencies in categorization settled by consensus. Inductive thematic analysis was applied to the open-ended survey questions with results collated in descriptive tables in line with framework analysis methodology by Ritchie *et al*. and as outlined by Gale *et al*.[22,23]

Descriptive statistics and multiple 1-way analysis of variance (ANOVA) were used to analyse the quantitative data collated for this study. A minimum significance level of $P < .05$ was chosen. A principal component analysis (PCA) with varimax rotation was conducted to investigate the interrelationships between subscores for the student data. Statistical analyses were conducted using SPSS Version 28 (IBM Corp. Released 2021) and GraphPad Prism version 9.3.1 for Windows (GraphPad Software, San Diego, CA, USA; www.graphpad.com).

In Australia, ethical approval was provided by the Umbrella Ethics for Assessment Collaborations in Medical Education Project number 2016/511 from The University of Sydney Human Ethics Research Committee extended to 2024 for all Australian medical schools who are members of the PSA collaboration. In New Zealand, ethical approval was provided by the university human ethics committees associated with each of the 2 medical schools (University of Auckland protocol number 023322, University of Otago reference number HD21/069).

3 | RESULTS

There were 21 accredited ANZ medical schools during the study period.[24] The number of participating schools increased markedly over time (Figure S1, Table S2). During 2017, 2018 and 2019, the ANZ PSA was delivered by 9 (42%), 11 (52%) and 12 (57%) ANZ medical schools, respectively. Data were shared from almost all collaborating schools during 2017, 2018 and 2019 including 8, 10 and 10 schools, respectively, providing a total of 28 out of 32 (88%) school-year-based data sets.

The student representativeness was also high with 52% of the graduating ANZ medical student population of 12 279 over the period 2017–2019 sitting the PSA.[24] The student representativeness increased over time, from 33% in 2017, 55% in 2018 and 69% in 2019, reflecting the increase in schools participating in the ANZ PSA collaboration.

3.1 | Research Objective 1: To evaluate student performance on the ANZ PSA

The first research objective was investigated regarding completion rates for the 5155 students who sat the PSA in 2018 or 2019. The 2017 data did not allow differentiation between a zero score and nonattempt for the subscores. In 2018 and 2019, almost all students (99–100%) completed the first 4 sections of Prescription, Prescription Review, Planning Management and Communication Information (Table S3). The completion rates were lower but still high for Calculation Skills (98%), Adverse Drug Reactions (97%), and a lesser extent Drug Monitoring (95%) and Data Interpretation (93%).

Figure 1 shows the mean score for each section and overall for 2017–2019 along with the passing standard. The overall passing rate was slightly higher in 2017, possibly reflecting the lower passing standard. The average pass rate for the participating schools was 89% in 2017, 85% for 2018 and 86% for 2019 for the 28 school-based data sets and 89%, 82% and 85% for the student-based data. The student pass rate significantly differed by year ($\chi^2 = 36.38$, $P < .01$).

Differences over time were further illustrated by the mean scores (Table 1). The assumption of homogeneity of variance across years was violated for several domain subscores ($P < .05$) according to Levene's test. The Welch robust test of equality of means was

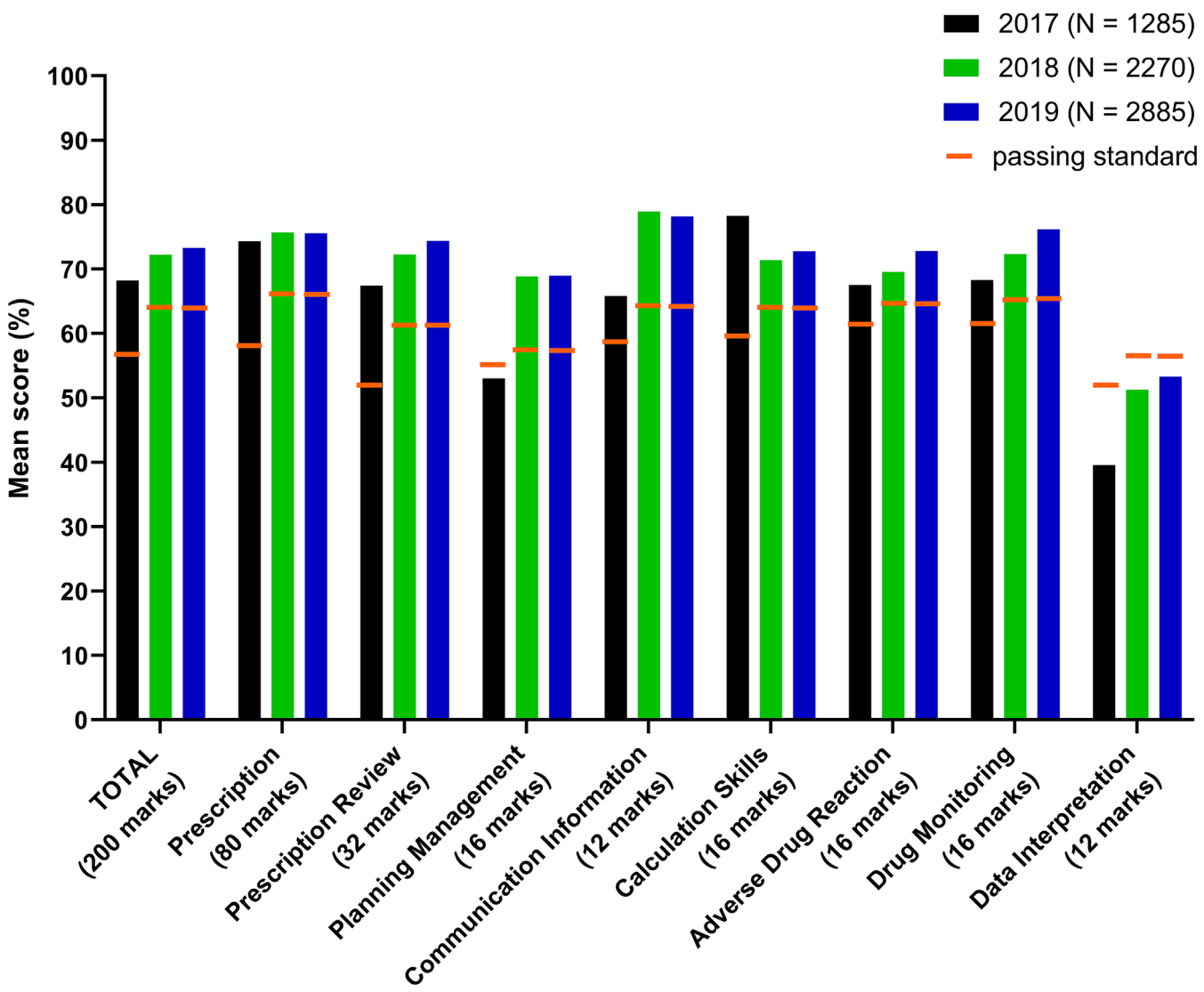

FIGURE 1 Prescribing Skills Assessment student-based mean total score and domain subscores (%) with passing standards.

TABLE 1 Prescribing Skills Assessment total scores and domain subscores for 2017–2019.

Results base: 6440 students	2017 ($n = 1285$) Mean (SD)	2018 ($n = 2270$) Mean (SD)	2019 ($n = 2885$) Mean (SD)
Total percent	68.2 (9.6)	72.2 (10.9)	73.3 (10.4)
Total marks (200 marks)	136.4 (19.2)	144.4 (21.7)	146.5 (20.8)
Prescription (80 marks)	59.5 (9.2)	60.6 (8.8)	60.5 (8.6)
Prescription Review (32 marks)	21.6 (4.3)	23.1 (4.4)	23.8 (4.1)
Planning Management (16 marks)	8.5 (2.8)	11.1 (2.6)	11.1 (2.5)
Communication Information (12 marks)	7.90 (2.2)	9.6 (2.2)	9.5 (2.2)
Calculation Skills (16 marks)	12.5 (3.3)	11.7 (3.7)	11.9 (3.8)
Adverse Drug Reaction (16 marks)	10.8 (3.1)	11.5 (3.2)	12.0 (3.0)
Drug Monitoring (16 marks)	10.9 (3.4)	12.2 (3.2)	12.8 (2.9)
Data Interpretation (12 marks)	4.7 (2.8)	6.6 (3.0)	6.9 (2.9)

SD, standard deviation.

therefore used for the ANOVA, finding that the total score and domain subscores were significantly different ($P < .01$) by year of implementation except for 4 comparisons between 2018 and 2019 (Prescription, Planning Management, Communication Information and Calculation Skills).

3.2 | Research Objective 2: To evaluate the variation in the ANZ PSA performance by school

The second research objective was based on data collected through the confidential online template, completed for 28 out of a possible 32 school assessments between 2017 and 2019. The mean total PSA score for the school-based data was 72.1% compared to 71.9% for the student-based data. The strong representativeness of the response rate of 88% is further supported by comparing the summary statistics from the school- and student-based data (Figure S2). Similarly, the student and school-based means for domain subscores only differed by <1.0 mark.

The intercorrelation between the 8 domain subscores in the student-based data was low, ranging from $r = .19–.39$, demonstrating low to moderate linear correlations but sufficient to warrant analysis of the dimensions. The PCA found 1 component explained 37.5% of the variance, with all subscores loading between .56 and .68. When conducted separately by year, a similar result was found for both 2018 and 2019, accounting for 37 and 35% of variance, respectively, with slightly more variance explained for 2017 student data, 49% by 2 components.

Some variability in the student-based data results from 2018 and 2019 occurred according to the 3 periods of the year that schools implemented the ANZ PSA. In 2018, 17% students sat the PSA during the Early period, 45% in the Middle and 38% during the Late period. In 2019, 34%, 40% and 26% sat the PSA in the Early, Middle and Late periods, respectively. According to ANOVA on combined data from 2018 and 2019, a significant difference ($P < .05$) by timing of sittings was identified for the total score and the domain subscores of Prescription, Prescription Review, Adverse Drug Reaction and Drug Monitoring. However, the direction of the difference was not significant or linear according to the Bonferroni test of multiple comparisons; for example for some domain subscores, students scored significantly higher for the Early *vs*. the Middle time period but not in comparison to the Late time period. As Levene's test was significant ($P < .05$) for 5 domain subscores and total score, Welch robust test was used for the ANOVA on time period.

3.3 | Research Objective 3: To evaluate the acceptability of the ANZ PSA to students

The third research objective used the post-PSA student survey. Completion rates of this survey for the medical schools that participated in this research study were very high, with an average school response rate being 87% for 2017, 94% for 2018 and 88% for 2019. The responses to questions on the ANZ PSA administration and format (Figure 2) demonstrate that layout and presentation were rated positively by most students as was the ease of using the interface. Although slightly less positive, the clarity of the questions was also rated positively. However, only 50% in 2017 and approximately 40% in both 2018 and 2019 thought there was sufficient time to complete the assessment.

When asked a prompted question on preparedness for the ANZ PSA, the majority of students reported low preparedness, although nonsignificantly different over time ($P > .05$). There was variation in the rating for preparedness between medical schools (Figure 3). These results are in part explained by the finding that the majority of medical students reported having <10 opportunities to write prescriptions during training: 68% for 2017, 71% for 2018 and 2019. Again, there were considerable differences in the numbers of prescriptions written within each medical school and between each medical school in this study (Figure 4).

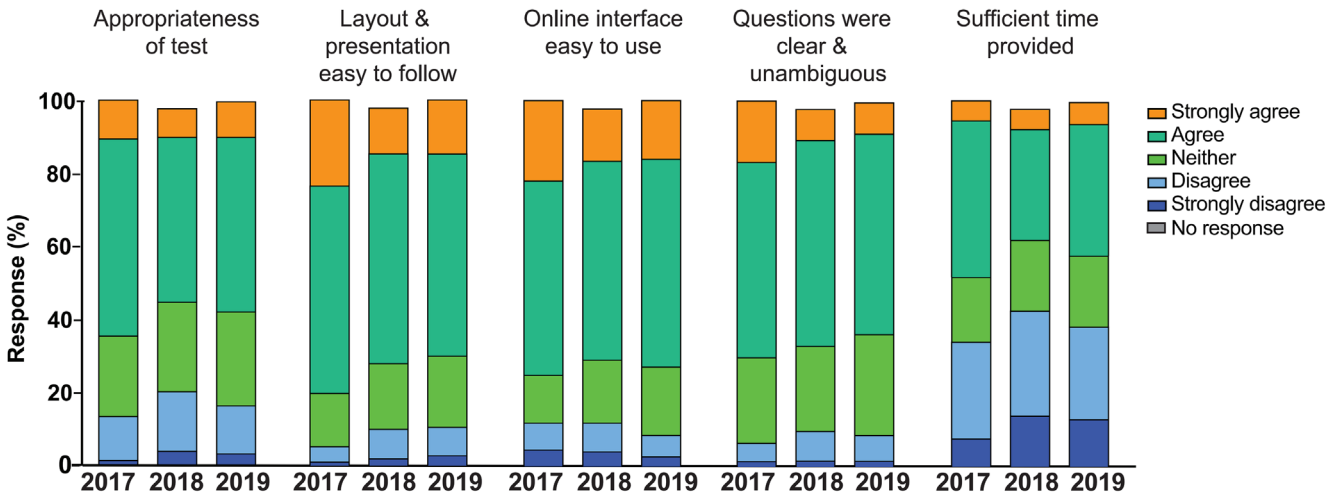

FIGURE 2 Usability of the Prescribing Skills Assessment 2017–2019.

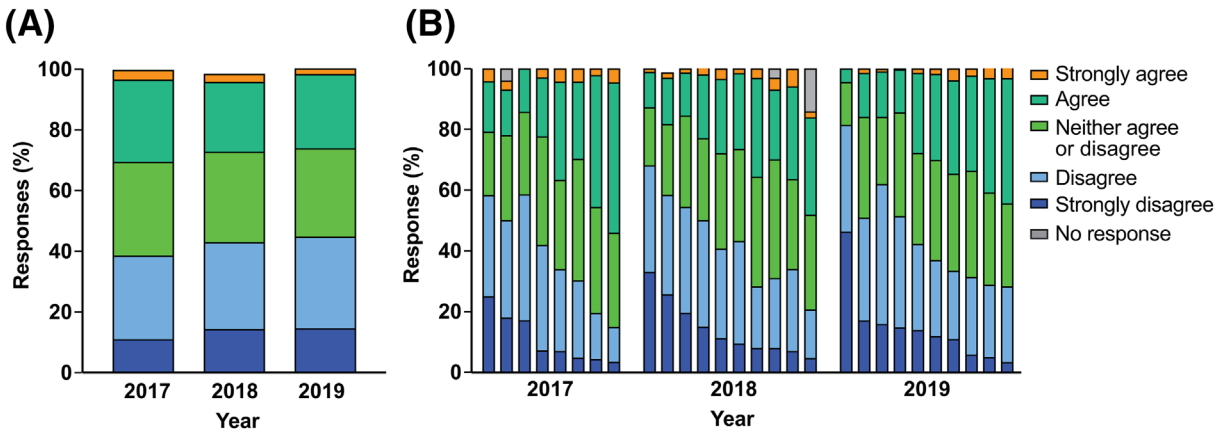

FIGURE 3 Student perceptions of their preparedness for the Prescribing Skills Assessment. There were 8 individual medical schools in 2017 and 10 in 2018 and 2019.

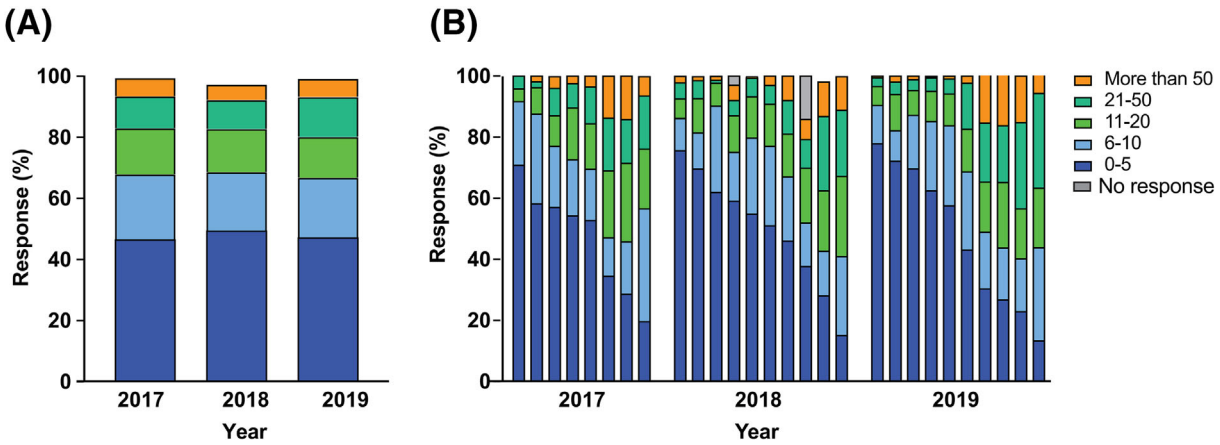

FIGURE 4 Average number of simulated prescriptions written by medical students prior to sitting the Prescribing Skills Assessment. There were 8 individual medical schools 8 in 2017 and 10 in 2018 and 2019.

Approximately 1 in 5 students responded to open-ended feedback in the ANZ PSA postexam survey with 1823 total responses. There were 391 responses that did not contain usable or relevant comments, leaving 1432 (78%) responses for analysis across the 4 open-ended questions. It should be noted that some students may have given several responses and some only 1; it was not possible to differentiate these due to the survey being anonymous.

Using inductive thematic analysis, 2 major themes described the aspects of the PSA that students found difficult: (i) insufficient time to complete assessment and (ii) feeling unprepared to answer questions related to specific areas of pharmacology. Together, the responses described in these themes reiterated feelings of under-preparation for prescribing through a reflection on the difficult areas of the assessment (subthemes: insufficient time to complete, content specific concerns, lack of preparation, lack of specific teaching on specific prescribing skills, lack of familiarity with available resources and perception of inappropriateness of questions set at intern level). A minority of students responded that they had adequate preparation for the PSA, describing the test as relevant and valuable.

"Although time management is an important part of being a junior doctor, I feel that the time allowed in this assessment does not reflect how much time you would get in a real world setting to make important decisions."

"Decisions to make diagnoses and prescribe certain medications based on clinical scenarios may be beyond what is expected of an intern."

"Difficult to pick specific adverse drug reactions when they have not been memorised."

"Data interpretation was more difficult than our level of expertise."

"The calculations were rather difficult as I have not previously had much experience or teaching on methods to do this."

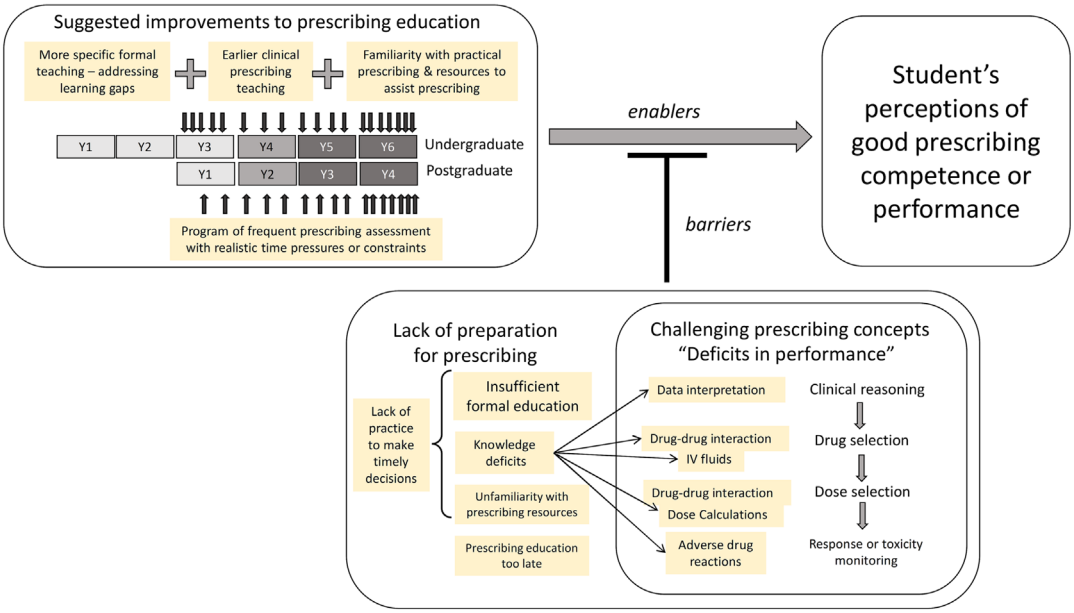

FIGURE 5 Barriers and enablers for student perception of preparedness for prescribing as a junior doctor.

A third smaller unrelated theme, where students found the assessment unclear or difficult, reflected student concerns about the technical requirements to sit an online exam (subthemes: poor interface, computer issues, internet connectivity and resource availability).

In response to the third open-ended feedback question, 2 major themes were identified for suggested improvements to the PSA: (i) to address lack of prescribing preparation and (ii) to improve the technical aspects of the test. Regarding improvements to prescribing skill preparation, the most suggested comment was the request for more time to complete the test. A second common subtheme was a call for formalized clinical pharmacology teaching with practical active learning with *hands-on* sessions in earlier stages of their medical programmes and in clinical settings, particularly in items that were found challenging throughout the test (e.g., identification of ADR, dose calculations, fluid prescribing and data interpretation).

> "I think more time should be given. In reality, we would not be so time pressured with prescriptions as that would increase the risk of mistakes."

> "More clinical experience for prescribing."

> "I think it should be included earlier in medical education with modules that start in the first clinical year. A lot of the prescribing content is taught in the last year of medical school, hence the uncertainty."

A diagram describing the student experience with education leading to preparation in prescribing skill development is summarized in Figure 5.

In the technical improvement theme, students commonly suggested addition of the Australian Therapeutic Guidelines (series of monographs with practical guidelines to complement formulary content) as an essential resource used in prescribing alongside formularies, improvements to connectivity to online platform and changes to the question interface (presentation of investigational results in tabular formats comparable to electronic health systems).

4 | DISCUSSION

The use of the PSA in Australia and NZ has grown over time from 1 school in 2015 to 13 of the 21 accredited ANZ medical schools in 2021. All ANZ medical schools that participated in the PSA from 2017 to 2019 contributed to this collaborative research through standard setting and/or data sharing, demonstrating the strong interest in evaluating this assessment tool.

In most ANZ medical schools, the PSA was introduced as a formative but mandatory assessment in the final year of the medical programme. However, after several years of staff and student familiarization and successful implementation, the PSA is transitioning in several schools to a summative assessment.

The ANZ PSA had high pass rates during 2017–2019, though lower than the 91–94% reported during the PSA establishment phase in the UK in 2014–2015, when it was also mainly used formatively.[13] There was some variability in ANZ school performance over time. Students performed significantly higher in some domain subscores for 2017 but not 2018/2019, which used a different examination paper. The performance in the Data Interpretation domain was lower than the others in all 3 years and is in part explained by this domain having the lowest completion rates. We found that the effects of implementation at different times of the final year of medical school were variable. The largest component of the test, Prescriptions, is a skill independent from the other domain subscores, which have low

overlap. As such our study provides evidence for the content validity of the PSA 8 domain subscores structure and the use of the overall score. Variance not explained by the subscores reflect individual differences in students and medical schools.

Most students reported that the ANZ PSA interface was easy to use, the layout easy to follow, and the questions clear and unambiguous. Students perceived that there was inadequate time available to complete the PSA. This may have reflected the known internet connectivity problems for some sittings during 2018 that affected access to formularies. However, limited test time may have educational validity in replicating time pressures of clinical decision making. Allowing each ANZ medical school to select the most suitable time of the year for their group of students to sit the assessment did not affect student performance. Further, there was no evidence of possible communication of test questions between groups causing increasing scores during the calendar year. This may reflect the notion that there was less incentive for interschool collaboration by students as the PSA was largely used formatively. The positive feedback that the assessment was relevant to their training needs was consistent with UK candidate feedback on the PSA.

The consistent quantitative and qualitative findings that ANZ medical students frequently reported that they were underprepared for the PSA aligns with previous studies for interns or junior doctors surveyed 6 months after graduation who report lack of preparedness for prescribing.[25] The findings of this study also align with studies and surveys conducted within Australasia as well as in the UK and Europe which reported that the majority of final year students and newly qualified doctors felt under-prepared in the practical aspects of prescribing. The reasons for the high pass rates despite these findings for the 2017–2019 ANZ PSA are unclear. This interesting observation is consistent with findings from other studies of students of healthcare professions, which report a lack of correlation between exam-related anxiety and exam performance.[26] One potential explanation is that the ANZ students sitting the ANZ PSA in their final year underestimated their pharmacological knowledge, because it is integrated into other specialties that comprise medical school curricula in the latter years of most medical programmes, whereas direct pharmacology teaching tends to occur in the earlier years.

More concerningly, the majority of students described low levels of practical prescribing experience during their training. Two-thirds of students reported completing <10 prescriptions during their medical course, although there was large variability across medical schools, with 15% or more from 3 medical schools writing >50 prescriptions (Figure 4). It is acknowledged that NZ medical graduates have a *trainee preinternship* year within their programme, which enables further clinical practice of prescribing under supervision with improved perceptions of preparedness.[27] The open-ended responses allowed an insight into the student perception of their needs for preparing them to be *good prescribers*. The ANZ student-identified challenges in clinical pharmacology knowledge and practice are consistent with the UK and Canadian medical student experience.[14,28] Reflecting on the relationships between the identified themes we have constructed a model of specific areas for curriculum development including reinforcement of clinically authentic teaching experiences, to address medical students' needs (Figure 5).

The present study demonstrates how a complex assessment such as prescribing can be adapted for the local context from a pre-existing assessment. In times of decreased financial resources for universities, particularly because of the pandemic, the ability to share and modify a complex but essential assessment such as the PSA globally needs further investigation. Similar to the previous study in Canada,[14] we have provided further evidence for the use of the PSA more globally. Outcomes and feedback from the PSA exams have led to some medical programmes adapting their teaching and implementing changes to address the identified areas where student skills need further development. New and innovative ways to improve student learning in the various clinical skill development areas needed for prescribing have been developed and implemented in different medical programmes.[29,30] Rich opportunities for building on core pharmacology knowledge can occur by design of relevant clinical scenarios for interactive student-led workshops, exposure to prescribing activities in workplace learning simulations and integrated bedside teaching and interprofessional activities with students in pharmacy and nursing for authentic team work in medication management experiences.[31,32] The collaboration between medical programmes in regionalizing and implementing the PSA activity in ANZ has created a useful environment for understanding differences in regional approaches to prescribing and formulary resources. The standard setting and item review for the PSA was an important part of the development of this collaboration of primarily pharmacology experts throughout ANZ medical schools.

A continued goal of our regional collaboration is a shared regional curriculum designed to achieve prescribing competence and confidence. This goal is informed by the deficiencies identified by looking at the PSA experience across schools and students. Prior successful, regional collaborations addressing prescribing competencies include the development of the National Prescribing Core Curriculum prescribing modules.

4.1 | Strengths

A strength of this study is that it is based on the population of students who sat the PSA in 2017, 2018 or 2019. The results are generalizable to all ANZ medical schools running the PSA, which included >50% of ANZ medical schools. The understanding of student experience is strengthened by use of multiple methods including closed-ended and open-ended questions, anonymously obtained. The student results and feedback have demonstrated high acceptability and informed curriculum development in the participating schools. We have provided evidence on the equivalence of the PSA over time, the feasibility of conducting it for ANZ and the educational and catalytic effects that are widely recognized as elements of good assessment.[21] Educational effects include the motivation it provides to those who complete it and the motivation for all stakeholders to use it for programme quality, both of which have been clearly demonstrated.

4.2 | Limitations

The study is a collaborative research project amongst medical schools that aimed to protect anonymity at 2 levels, student and medical school. As such, the results are based on aggregated school and domain data in part because the BPS has the proprietary ownership of item level data under the current PSA contractual arrangements. Information about the timing of sitting of the PSA was only available for 2018 and 2019, which also used the same examination paper. School-level data were collated from 28 out of a possible 32 school-year-occasions over the 3 years, and missing data were primarily due to changes in staff and responsibilities rather than an unwillingness to be part of this research collaboration (personal communications, C.H., D.O., 2021). Due to the constraints of the data collection, ethics and contractual arrangements, it was not possible to link student responses to the results or conduct reliability analyses using item level data. This is an area of future research that could be explored.

5 | CONCLUSION

The PSA has been implemented at more than half of the medical schools in ANZ, with high pass rates, little variability over time or between schools and overall positive feedback from students. Ongoing sustainability of the PSA in ANZ will require endorsement and resourcing from key stakeholders, from education, clinical, health service and regulatory sectors, informed by the findings of this paper. Given increasing financial priorities for universities, sharing resources that can be modified may be a useful future direction. Assessment of prescribing competence is an important tool to drive education in clinical pharmacology and therapeutics and is 1 of many strategies required to improve prescribing in practice. This study has provided a baseline to benchmark future educational innovations and identified gaps to address in education and training in order to improve medical student preparedness to prescribe safely and effectively after graduation.

AUTHOR CONTRIBUTIONS

All the authors have made substantial contributions to the conceptualization of the study. Claire Harrison, Deborah O'Mara, Kellie Charles and Sarah N. Hilmer contributed to designing the study. All authors contributed to data collection. Deborah O'Mara, Bridin Murnion, Catherine Lucas, David Joyce, David Reith, Kellie Charles, Paul K. L. Chin and Treasure M. McGuire contributed to data analysis. All authors contributed to drafting and editing the manuscript, several rounds of critical revision and approval of the final manuscript.

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CONFLICT OF INTEREST STATEMENT

None to declare for all authors.

DATA AVAILABILITY STATEMENT

Data are not available to share with other investigators due to limitations of ethics approval.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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