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RESEARCH

Assessing the readiness and confidence of 4th–year University of Notre Dame, Sydney medical students to prescribe effectively

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SUMMARY

Prescribing is a well-known source of anxiety and perceived weakness for graduating medical students. Fourth-year medical students at the University of Notre Dame, Sydney tested a learning tool designed to assess students' confidence in prescribing. The study results show that students performed significantly better in topics that had previously been formally taught. All of the students who completed the post-survey found the learning tool useful. The results support the need for greater emphasis on prescribing and pharmacology teaching in the clinical years of the medical curriculum.

Key Words

Education; medical students; pharmacology, prescribing

ABSTRACT

Background

Prescribing errors and adverse drug reactions are known to lead to serious harm in patients, both in the community and hospital settings. Medical interns have expressed concern regarding their competency to prescribe safely, and surveys have found that most interns feel that they are not adequately prepared to prescribe upon graduation. Similarly, surveys of final-year medical students have shown that most students do not feel confident or adequately prepared to prescribe in their intern year.

Aims

The aim of this study was to provide 4th–year medical students at the University of Notre Dame, Sydney (UNDS) with a learning tool designed to help strengthen their prescribing skills and increase their confidence to prescribe. The study also conducted surveys to obtain qualitative and quantitative data about students' perceptions of their knowledge of prescribing and pharmacology, and the adequacy of the teaching of clinical pharmacology and prescribing in the School of Medicine curriculum.

Method

We developed a learning tool comprising 18 multiple choice questions designed to illustrate common scenarios graduates were likely to experience during their intern year. The questions aligned with five domains: Adverse Drug Reactions (4 questions), Planning Management (4

questions), Choosing the Correct Therapeutic Options (4 questions), Calculations (3 questions), and Therapeutic Drug Monitoring (3 questions).

Seven of the questions were designed to address learning topics that the students had been taught during their pre-clinical pharmacology teaching in years 1 and 2, while the other eleven questions were related to learning in the clinical years. Prior to completing the learning tool, we asked students to complete a pre-survey that was designed to measure the level of their perceived knowledge and confidence to prescribe in their upcoming intern year.

After completing the learning tool, we asked students to complete a post-survey that was designed to measure any changes that may have occurred in the level of their perceived knowledge and confidence to prescribe because of the learning tool. Students were also able to give de-identified feedback on any perceived deficiencies in the teaching of clinical pharmacology and prescribing in the current medical program, and to suggest how these may be addressed.

We invited all 4th–year medical students to complete the learning tool, which was an untimed, open-book exercise.

Conclusion

After finishing the learning tool, all students who completed the post-survey indicated that they found the learning tool to be a valuable exercise. The students performed better in those questions that addressed topics taught formally in the preclinical years. After completing the learning tool the students' perceived confidence level increased significantly in the areas of Therapeutic Drug Monitoring, Use of Therapeutic Drug Monitoring to Adjust Dose, and Dosage Calculations.

Most students indicated they felt "not very confident" in their prescribing skills, which they attributed primarily to a lack of formalised training during the clinical years of their coursework. Lack of knowledge regarding correct doses and the frequency of administering prescribed medications was the greatest concern expressed by students. The results suggest that students would benefit from more structured clinical pharmacology and prescribing teaching during the clinical years of the curriculum.

BACKGROUND

Prescribing errors and adverse drug reactions are known to cause serious harm in patients. In 2019, 400,000 people visited hospital emergency departments in Australia due to harm resulting from their medications, including prescribing errors, inappropriate use, and interaction between two or more drugs.[1] Every year, 250,000 Australians are hospitalised after mixing medications, or experiencing drug side effects.[2]

Prescribing errors and adverse drug reactions also occur during inpatient hospital care and interns have expressed concern regarding their ability to prescribe safely. Between 2017–2019 the Australian Medical Council and Medical Board of Australia conducted joint surveys: results showed that interns expressed concerns that they were not adequately prepared to prescribe upon graduation.[3] In the United Kingdom (UK), 7–10 per cent of the prescriptions written by newly graduated doctors in hospitals contain errors ranging from minor to life-threatening.[4] In a 2019 survey, 25 per cent of the final-year students at the University of Notre Dame, Sydney School of Medicine indicated that they were "not at all prepared/poorly prepared" to prescribe safely, with a further 48 per cent indicating they were only "somewhat prepared".[5]

Another survey of medical students enrolled at Monash University reported that the students would like more formal pharmacology and therapeutics to be taught across their course, and to be provided with greater prescribing practise in the final year of their programme.[6] When the final-year students were asked about their greatest concern regarding their prescribing role as an intern, the most common response related to not knowing the correct dose and drug interactions.[6]

Given these studies, it seems logical to question whether there is adequate structured teaching of clinical pharmacology and prescribing in the final years' curricula of Australian medical schools.

In 2014, to assess the competence of final-year medical students to prescribe and supervise the use of medicines, the British Pharmacological Society and Medical Schools Council Assessment developed the Prescribing Safety Assessment (PSA).[7] This is a summative assessment designed for medical students at the end of their undergraduate training to demonstrate "that they have achieved the necessary competence to prescribe and supervise the use of medicines at the standard expected of a foundation doctor".[7]

Since 2016 several medical schools in Australia have introduced a prescribing assessment for final-year medical students known as the Prescribing Skills Assessment, which has been adapted from the UK's PSA. The Prescribing Skills Assessment tests multiple prescribing domains including prescription review, dosage calculations, and adverse effects.[8]

The aim of this study was to provide 4th–year medical students at UNDS with a learning tool designed to help strengthen their prescribing skills, and to obtain qualitative and quantitative data on the students' perceptions of their knowledge of prescribing and pharmacology. We also collected data on the students' perception of the adequacy of the teaching of clinical pharmacology and prescribing in the medical curriculum.

At the time they were offered the learning tool, the 4th–year medical students at UNDS had not participated in the Prescribing Skills Assessment.

METHOD

Learning tool and surveys

The learning tool consisted of 18 multiple choice questions that were marked as either correct or incorrect with no negative marking. We designed the questions around common scenarios graduates might experience during their intern year. The questions were aligned with five domains: Adverse Drug Reactions (4 questions), Planning Management (4 questions), Choosing the Correct Therapeutic Options (4 questions), Calculations (3 questions), and Therapeutic Drug Monitoring (3 questions) (Table 1). While we aligned the domains primarily with those of the PSA,[6] we developed the questions in the learning tool specifically for the current study.

We designed seven of the questions to address learning topics that the students had been exposed to during their pre-clinical pharmacology teaching in years 1 and 2, while the other eleven questions related to learning in the clinical years. We also intended the students to use the questions as a self-reflective activity relating to their confidence in managing the scenarios.

Table 1: Definitions of the domains used to guide the formation and analysis of the knowledge and skills required for each domain (modified from the Prescribing Skills Assessment)

Domain Name	The assessing objective(s) of the domain
Adverse Drug Reaction	This style of question requires the participant to: • Recognise the most likely adverse effect of drugs. • Consider presentations that could be caused by an adverse drug reaction. • Detect, respond to, and prevent potential adverse drug reactions.
Planning Management	This style of question requires the participant to: • Demonstrate the ability to plan appropriate treatment for common clinical presentations. • Request the most important treatment that would be part of initial management.
Choosing the Correct Therapeutic Options	This style of question requires the participant to: • Choose the correct therapeutic option from a list of five based on the indication, dosage frequency, and dosage. • Choose the correct option from a list of five, based on the patient's co-morbidities.
Calculations	This style of question requires the participant to: • Make an accurate calculation regarding dosing, dosing frequency, or usage of formulae to guide therapeutic management.
Therapeutic Drug Monitoring	This style of question requires the participant to: • Make a judgement about how best to assess the impact of treatments that are ongoing. • Interpret the clinical data from therapeutic drug monitoring to make appropriate therapeutic decisions.

Prior to completing the learning tool, we asked students to complete a pre-survey that was designed to measure the level of their perceived knowledge and confidence to prescribe in their intern year. After completing the learning tool, students were shown worked solutions to each question, including references and resources to help them understand and reflect on any areas of weakness.

We asked students to complete a post-survey that was designed to measure any changes that may have occurred in the level of their perceived knowledge and confidence to prescribe because of the learning tool. Students in the post-survey were also able to give de-identified feedback on any perceived deficiencies in the teaching of clinical pharmacology and prescribing in the current medical program, and how these may be addressed.

We assessed some survey questions quantitatively using a 5-point Likert scale, and others had freestyle text allowing the students to provide feedback. We analysed this feedback using thematic analysis.

Participant recruitment

We invited all enrolled 4th–year students in the class of 2020 to take part in the study. We sent an email containing the participant information sheet to students asking for their voluntary

participation. The link provided took the students to Qualtrics, a survey software used in the study. Students were then prompted to either consent to taking part in the study or exit the website. When the student consented, an anonymous link to the activity was then provided allowing them to access the pre-survey. Once the student completed the pre-survey, they could start the learning tool. The learning tool was an untimed, open-book exercise, and the students could view and answer one question at a time.

Qualtrics software

Qualtrics is an online program that allows dynamic surveys to be administered to participants and responses collated. Qualtrics allowed each individual participant to be "de-identified" using a unique Qualtrics code that was randomly generated when the student entered the survey. This code was kept consistent for the entire activity. Therefore, it allowed successful de-identification, while ensuring each student could be longitudinally tracked.

RESULTS

Of the 117 students enrolled in 4th–year Medicine at UNDS, 58 students (49.6 per cent) attempted the learning tool. Of these 58 students, 45 completed the clinical questions along with both pre- and post-Likert scale surveys. We removed those students who did not complete all the quantitative survey questions to prevent a skewing of the results. Students who included answers in the freestyle text questions but may not have completed other parts of the learning tool were included in the analysis of the freestyle text, as this would not affect the statistical analysis of the quantitative data.

Each question was worth one mark with no negative marking. The maximum mark was 18. The mean mark for the 45 students was 12.09 with the marks ranging from a low of 7 to a high of 17. We present the overall results for each domain (Table 2).

Table 2: Average results from each of the domains

	Mean % of students answering the question correctly ± SD
Adverse Drug Reactions	73.50 ± 26.0
Planning Management	75.25 ± 30.61
Choosing the Correct Therapeutic Option	50.0 ± 23.71
Calculations	83.67 ± 20.65
Therapeutic Drug Monitoring	61.33 ± 12.01

Questions that addressed concepts taught in their pre-clinical pharmacology lectures had a mean mark of 83.6% ± 10.8% (SD). Those not previously taught in formal pharmacology lectures had a mean mark of 56.7% ± 24.7% (SD). However, if we took the domain of calculations out of the data (due to this being simple arithmetic), the mean mark for those questions not formally taught previously was only 47.8% ± 17.7% (SD). We provide further details (Table 3).

Table 3: Breakdown of participant performance based on the domain and if the topic of assessment had been previously taught to the students

Question	Domain	% of students that answered the question correctly	Previous teaching of concept in pre-clinical years 1 and 2 pharmacology lectures
1A	Adverse drug reactions	76%	Yes
1B	Adverse drug reactions	91%	Yes
2	Planning management	31%	No
3	Planning management	100%	Yes
4	Adverse drug reaction	36%	No
5	Planning management	80%	Yes
6	Choosing the correct therapeutic option.	51%	No
7	Planning management	69%	Yes
8	Adverse drug reactions	91%	Yes
9	Calculations	98%	No
10	Calculations	93%	No
11	Therapeutic Drug Monitoring	62%	No
12	Choosing the correct therapeutic option.	20%	No
13	Therapeutic Drug Monitoring	49%	No
14	Therapeutic Drug Monitoring	73%	No
15A	Choosing the correct therapeutic option.	51%	No
15B	Calculations	60%	No
15C	Choosing the correct therapeutic option.	78%	Yes

Qualitative results

We graded the pre- and post-survey questions on a Likert scale: 1=Strongly disagree, 2=Somewhat disagree, 3=Neither agree nor disagree, 4=Somewhat agree, and 5=Strongly agree.

Pre-activity survey questions

How well prepared do you feel to prescribe safely during your internship? Please provide an explanation for your answer.

Of the 49 students that responded, 65 per cent indicated they did not feel very confident in prescribing during their internship, 20 per cent felt somewhat confident, and 14 per cent felt confident.

Comments included students stating they *"need more practise"*, it's *"hard to get experience in quick ward rounds"*, and it's a *"real gap in knowledge in the skillset*. The few students that were confident felt they *"know where to find the information"*.

Post-activity survey questions

1. *Did you find this activity a valuable learning tool? Please provide a reason for your answer.*

The students who completed the learning tool and the post-survey unanimously thought that completing the learning tool was a valuable exercise. Students said: *"Good test of knowledge. Often parameters are taught not in clinical practice. Good to see how it would be used in clinical practice."*; *"Required application of knowledge in real scenarios"*; and *"highly practical–relatable"*. Many students indicated the exercise boosted their confidence in their skills—for example, *"I know more than I think. It also identified knowledge gaps"*.

2. *Do you think it would be beneficial for the students to have structured teaching during clinical years regarding clinical pharmacology and safe prescribing—for example, case-based tutorials, like clinical cases you saw—to aid in improving prescribing competency? Please provide a reason for your answer.*

The students that responded agreed unanimously that there was a need for structured clinical pharmacology and safe prescribing teaching within the course. Student feedback included that *"this essential knowledge is lacking in our curriculum"*. Students indicated they *"Appreciate this type of teaching. Additional teaching such as this are great ways to learn"*. Others mentioned that this was the *"first time I had something like this, ever. Need to practice, don't want to practice on patients"* and that it would be an *"important improvement in the course"*.

3. *On reflection, what aspects of prescribing are you most confident with—for example, dosing, indications, frequency, indications?*

Fifty-seven per cent of the students that responded felt their strengths in prescribing lay in knowing the correct indication. Others included dosing and frequency (18 per cent), contraindications (10 per cent), adverse effects (8 per cent), mechanism of action (4 per cent), and calculations (2 per cent).

4. *On reflection, what aspects of prescribing do you find most difficult?*

Forty per cent of the students that responded felt their difficulties lay in selecting appropriate dosage and frequency of medications. This was more than double the next greatest difficulty, clinical interactions (17 per cent) (Figure 1).

5. *Perceived confidence in matters relating to prescribing.*

The results of the post-survey showed that after completing the learning tool and seeing the correct answers, the students' perceived confidence level increased significantly in the areas of Correct Indications and Dosage, Drug Interactions, Therapeutic Drug Monitoring, Dosage Calculations, and Use of Therapeutic Drug Monitoring to Adjust Dose (Table 4).

Figure 1: Breakdown in participant responses regarding what aspects of prescribing they find most difficult

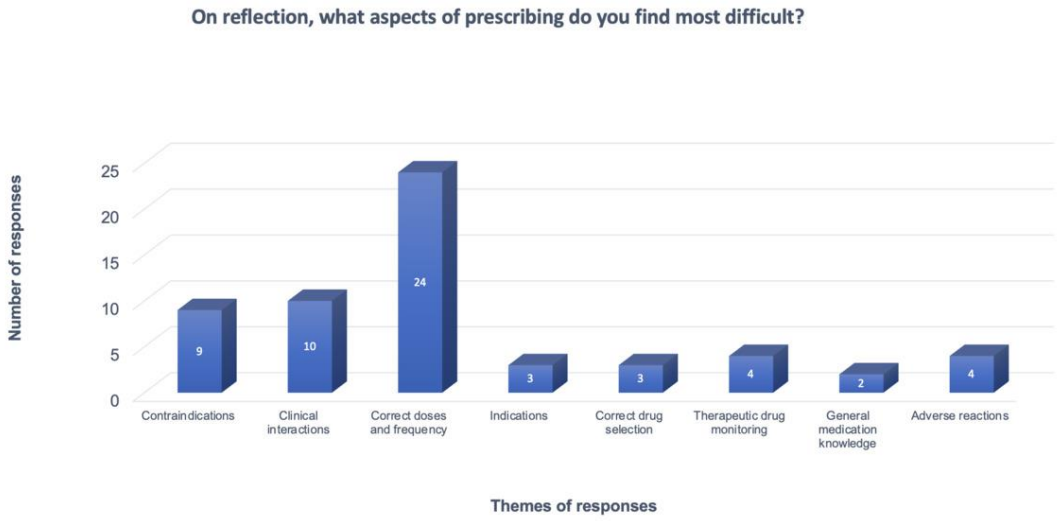

Table 4: The change in the participant's perceptions in various aspects of prescribing after undertaking the learning tool and receiving worked solutions

Confidence with	Pre-survey average ± SD	Post-survey average ± SD	Average change from pre- to post-survey in student confidence with *p* value
Correct indications, dosage, and frequency of administration.	2.96 ± 0.93	3.24 ± 0.88	+ 0.28 (p = 0.02)
Contraindications	3.11 ± 0.84	3.16 ± 0.90	+ 0.04 (p = 0.34)
Main adverse events (side effects) that may occur.	3.47 ± 0.79	3.38 ± 0.89	- 0.09 (p = 0.23)
Main drug interactions that may occur.	2.91 ± 1.02	3.13 ± 0.92	+ 0.22 (p = 0.04)
Therapeutic drug monitoring	2.78 ± 1.06	3.07 ± 0.89	+ 0.29 (p = 0.005)
Calculate the correct dose of a medicine based on a patient's individual parameters.	3.2 ± 1.08	3.89 ± 0.88	+ 0.69 (p = 4.0E-6)
Use therapeutic drug monitoring to adjust the doses of medicines.	2.78 ± 1.00	3.4 ± 0.94	+ 0.62 (p = 2.3E-5)

DISCUSSION

The learning tool was offered to all 4th–year medical students, and approximately 50 per cent of students participated in the exercise. Overall, the students who completed the learning tool performed well with the mean score being 67.7 per cent with marks ranging from a low of 39 per cent to a high of 94 per cent. Only three students obtained a mark below 50 per cent.

The results indicated that as a group the students who undertook the learning tool were competent in all the domains tested, although the mean score for "Choosing the Correct Therapeutic Option" was only 50 per cent. Except for "Calculations", it is also important to note that even though the students performed well overall in each domain, they answered some questions poorly, which suggest that there may be some gaps in their knowledge.

Seven questions in the learning tool related directly to information the students had been taught in the preclinical years, and the students performed significantly better on these questions when compared to the eleven other questions that covered topics not previously addressed in their preclinical years (83.6% ± 10.8 versus 56.7% ± 24.7 (mean ± SD, p value < 0.05). In addition, three questions relating to dosage calculations were included in the 11 questions not previously covered in the preclinical years. If these three questions are removed (as they tested basic mathematical skills), the difference in the students' performance between the two groups of questions becomes even more significant (83.6% ± 10.8 versus 47.8% ± 17.7 (mean ± SD, p value < 0.05), indicating that students perform much better when they are taught pharmacology topics explicitly as part of the formal curriculum.

After completing the learning tool and seeing the correct answers, the students' perceived confidence level increased significantly in the areas of Correct Indications and Dosage, Drug Interactions, Therapeutic Drug Monitoring, Dosage Calculations, and Use of Therapeutic Drug Monitoring to Adjust Dose, which suggests that completing the learning tool and seeing the correct answers was a worthwhile learning exercise for the students. After completing the learning tool and seeing the correct answers, some students may have realised that they knew more than they thought and had underestimated their initial knowledge in these areas.

Sixty-seven per cent of respondents felt "not very confident" in their prescribing skills, which they attributed to a lack of formalised training during the clinical years of the course. Many students felt they were confident in their ability to use the various resources to prescribe medications. This was reassuring, as knowing and using optimal resources is a crucial component of prescribing safely.

Most students (58 per cent) felt the best way to learn prescribing in the clinical years was through case-based learning (CBL) in tutorials, and practice assessments such as the learning tool used in this study. CBL has long been recognised as an enjoyable way to learn and teach: students report that apart from being enjoyable, CBL also enhances their learning; teachers report that CBL is an engaging and motivating way to teach.[9]

All students who completed the learning tool and the post-survey found it to be a valuable exercise, which suggests that the students would value further prescribing practice through case-based scenarios. Students were also unanimous in their request for structured teaching of prescribing to be standardised across all clinical schools.

In assessing the students' confidence regarding areas of prescribing, 57 per cent of students felt most confident in knowing correct indications for the medications prescribed. Indications is a key area of pharmacology taught during pre-clinical years. This foundation is further built upon

during their clinical rotations, where supervisors often emphasise knowing the correct drug indication in comparison to the other aspects of prescribing.

The greatest concern expressed by participants was their lack of knowledge around dosages and dosage frequency of prescribed medications. This concern could be attributed to a lack of teaching on dosing throughout their student journey. Medical students are often taught about the class of medications, their mechanism of action, and their potential side effects; it seems they are rarely taught the correct dosage and dosage interval of medications. While it may be appropriate to teach dosage and dosage intervals in the clinical years, this may not eventuate due to a lack of formalised pharmacology teaching. Coupling this with quick ward rounds and a lack of consistent and unpredictable pharmacology teaching in hospitals, the lack of student knowledge in these areas is understandable.

CONCLUSION

In this study, the students performed better in those questions that addressed concepts taught formally in their pre-clinical pharmacology lectures, and performed less well in areas that were not formally taught in the clinical years. These findings clearly suggest a need exists for more formalised and structured clinical pharmacology teaching in the clinical years of the medical program. This training should be made available consistently throughout all the clinical schools to allow students to become more confident in prescribing.

A clear strength of this study was that every student who completed the learning tool and post-survey found it to be a useful activity and wanted something similar in the future to try and avoid any anxiety related to prescribing during their intern year. Student feedback also showed that most students preferred case-based scenario teaching in tutorials, or case-based scenarios integrated into practice quizzes such as those in the learning tool used in this study. This teaching could be integrated into the curriculum as pharmacology tutorials during back-to-base days allowing for all the clinical schools to take part, resulting in consistency of teaching. Based on student feedback this teaching should involve some topics that focus on dosing and dosing intervals, as well as the correct charting of medications.

LIMITATIONS

Although all the 4th–year medical students were given the opportunity to complete the learning tool, close to 50 per cent of the students chose not to participate. Although we do not know why, one possible explanation for this could be that the learning tool was offered to the students in August, which was only a few months away from their final summative exams, and these students may have had other learning priorities. Another explanation for the students not participating is that they already felt confident in their prescribing skills. This explanation seems unlikely, however, given the consistent feedback to the contrary from those students who did participate in the learning tool.

REFERENCES

1. Pharmaceutical Society of Australia Ltd. Medicine Safety: Take care. [Internet]. January 2019. [Accessed 2022 MAY 1]. Available from: https://www.psa.org.au/wp-content/uploads/2019/01/PSA-Medicine-Safety-Report.pdf
2. Lim R, Ellett L.M.K., Semple S., et al. The Extent of Medication-Related Hospital Admissions in Australia: A Review from 1988 to 2021. *Drug Saf*. 2022 Mar;45(3):249-257. doi: 10.1007/s40264-021-01144-1
3. Australian Medical Council Limited. National Preparedness for Internship Survey 2017–2019: Evaluation Report: 2021 August. [Internet]. [Accessed 2022 MAY 1]. Available from:

https://www.amc.org.au/wp-content/uploads/2021/12/Intern-Survey-evaluation-report-FINAL-for-website.pdf
4. Maxwell SRJ, Cameron IT, Webb DJ. Prescribing safety: ensuring that new graduates are prepared. *Lancet* [Internet]. 2015 Feb 14;385(9968):579–81. doi: 10.1016/S0140-6736(14)62339-4
5. Australian Medical Council and Medical Board of Australia. 2019 Preparedness for Internship Survey. [Internet]. 2019. [Accessed 2022 MAY 1]. Available at: https://www.amc.org.au/wp-content/uploads/2019/11/National-Report-2019-Survey-FINAL.pdf
6. Bullock S, Leversha A. Medical student perceptions of their knowledge and skills in pharmacology in their first and final clinical years. *MedEdPublish*. doi: 10.15694/mep.2019.000042.1
7. Maxwell SRJ, Coleman JJ, Bollington L, Taylor C, Webb DJ. Prescribing Safety Assessment 2016: Delivery of a national prescribing assessment to 7343 UK final-year medical students. *British Journal of Clinical Pharmacology*. 2017 Jun 13;83(10):2249–58. doi: 10.1111/bcp.13319
8. Harrison C, Hilmer S. The Prescribing Skills Assessment: a step towards safer prescribing. *Australian Prescriber*. 2019 Oct 1;42(5):148. doi: 10.18773/austprescr.2019.050
9. Thistlethwaite JE, Davies D, Ekeocha S, et al. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. *Medical Teacher*. 2012 May 11;34(6):e421–44. doi: 10.3109/0142159X.2012.680939

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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