Online survey on subjective and objective competency in clinical pharmacology skills among final year Australian medical students: a pilot study

Linda K. Kemp, Arduino A. Mangoni and Richard J. Woodman

Adequate training in clinical pharmacology (CP) is considered essential to produce medical graduates who can provide safe and effective prescribing. National and international curriculums for CP teaching generally cover the following domains: knowledge and principles of CP, skills and attitudes [Orme *et al.* 2002; ASCEPT, 2011; CIOMS, 2012]. Two main approaches have been used by medical schools to objectively assess CP and prescribing competency: a list of core drugs, known as a student formulary, that students must know; and a list of common clinical conditions that students must be able to manage [Orme *et al.* 2002].

The Flinders University Medical School in Adelaide, Australia, has adopted the CP curriculum devised by The Australasian Society of Clinical and Experimental Pharmacology and Toxicology (ASCEPT) for its 4-year postgraduate medical course [ASCEPT, 2011]. No specific student formulary is used but a list of common conditions is provided to students in their penultimate year. There is no distinct CP topic in the medical curriculum at Flinders University. Instead, CP is integrated into 'system' based modules across the 4 years of study. CP teaching occurs through lectures, self-directed web-based learning, problem-based learning, case discussions, tutorials and opportunistic learning during clinical rotations. No objective assessment of CP skills, particularly prescribing skills, is performed throughout the medical curriculum at Flinders University.

This approach to CP skills teaching and assessment is not uncommon. Less than 20% of UK medical graduates consider themselves to have

undertaken a distinct CP course and less than 15% believe that specific assessment in CP was undertaken [Heaton *et al.* 2008]. By contrast, 60% of UK schools reported having a dedicated course in CP, although in most cases there was vertical integration [O'Shaughnessy *et al.* 2010]. The majority (90%) of schools also reported specific assessment of CP. Lack of signposting may contribute to a student's lack of awareness of CP delivery and assessment [Ross and Maxwell, 2012].

Improving the CP skills of medical students can be achieved through e-learning programs, student formularies, interprofessional learning, preprescribing and ward-based tutorials focused teaching and greater clinical exposure [Scobie *et al.* 2003; Sandilands *et al.* 2011; Ross and Maxwell, 2012]. However, a systematic review of educational interventions to improve the prescribing of junior doctors showed a lack of high quality studies [Ross and Loke, 2009]. Other factors in addition to the structure and content of the medical curriculum can also affect student competency including personality, number and type of clinical placements, shadowing and the support of others [Illing, 2008]. Although most medical schools in the UK believed that their medical graduates were 'well' to 'fairly well' prepared, only 37% actually assessed graduate competencies [O'Shaughnessy *et al.* 2010].

There is no information on the adequacy of CP training and competency among final year medical students in Australia. In an online test survey, approved by the local ethics committee (SAC HREC, reference number 186.13), final year

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Table 1. ASCEPT standards and questions used to objectively assess clinical pharmacology competency in medical students.

Standard	Pilot question
Monitor the therapeutic and toxic effects of drug therapy through medication concentrations, pharmacodynamic responses and clinical outcomes	You are in clinic and see a 40-year old man, 70 kg with epilepsy receiving a stable dose of phenytoin of 300 mg/day. He has had no seizures for 2 years and has no other health problems. You decide to measure his plasma phenytoin concentration and results come back as 23 mg/l (normal range: 10–20 mg/l). Assuming the sample was taken and analysed correctly what would you do?
Detect and report adverse drug reactions	How would you identify a potential adverse drug reaction (ADR)? How would you report an ADR?
Establish an accurate medicines history including prescription, nonprescription and complementary medicines, adverse drug reactions and information on adherence to therapy	When taking a medicine history, how often would you ask about: prescription drugs, over the counter/nonprescription drugs, complementary/herbal, vaccinations, ADRs, adherence to therapy, drug allergies, medications recently ceased or changed?

postgraduate medical students at Flinders University were asked to rate their subjective competency by responding to the question 'How do you rate your pharmacology skills?'. This was assessed using a four-point scale: 'extremely well prepared', 'well prepared', 'fairly well prepared' and 'not prepared'. Multiple choice questions relating to clinical scenarios were used to assess objective competency in therapeutic drug monitoring (4 possible responses) and ability to successfully identify (12 possible responses) and report adverse drug reactions (ADRs, 13 possible responses, Table 1 and Figure 1). The ability to take an accurate medicines history was assessed by asking participants to rate how frequently they ask about (1) prescription drugs, (2) over the counter medications, (3) herbal medications, (4) vaccinations, (5) ADRs, (6) adherence, (7) allergies and (8) changes to medications. Respondents had a choice of 'always', 'sometimes', 'rarely' or 'never'. We used previously defined international criteria for achieving competency in the different skills [WHO, 2002; ASCEPT, 2011]. Ability to establish an accurate medicines history was achieved if respondents 'always' inquired about prescription, non-prescription, complementary medicines, ADRs and information on adherence to therapy.

Competency in detecting ADRs was achieved if respondents considered the time course of drug action, withholding or reducing medications and alternative causes unlikely. Competency in reporting ADRs was achieved if respondents reported

them to the Therapeutic Goods Administration either by email, telephone, online or via a blue Adverse Drug Reactions Advisory Committee form. Ability to monitor the therapeutic and toxic effects of drug therapy was defined as respondents correctly identifying that for the defined patient with epilepsy (Table 1), a slightly elevated phenytoin concentration in conjunction with good seizure control does not require dose adjustment (Figure 1).

A total of 58 of the 121 final year medical students answered the questionnaire (48% response rate). Half the students considered themselves as 'not well prepared', 23 (40%) as 'fairly well prepared', 6 (10%) as 'well prepared', and none as 'extremely well prepared'. Overall objective competency was achieved in 10 out of 58 subjects (17.2%) compared with 29 subjects (50.0%) who subjectively rated themselves as being 'fairly well prepared' or 'well prepared'. Only 24 of the 48 subjects identified as not being objectively competent overall rated themselves as 'not well prepared' ($p < 0.001$ for agreement). Two-thirds (65.5%) of participants were identified as being competent in relation to therapeutic drug monitoring. Competency was similar between those studying in urban *versus* rural areas, males and females, and students <28 and ≥ 28 years of age (Table 2). Of the 38 subjects (65.5%) who demonstrated competency, 20 rated themselves as being 'fairly well prepared' or 'well prepared', and of the 20 subjects not considered competent, 11 identified themselves as 'not well prepared'.

- 1) What is your current level?
☐ Internship ☐ Fourth year
- 2) If you attended Flinders Medical School where were you placed for your 3rd year?
☐ Flinders Medical Centre ☐ Other Flinders sites (eg. NT, PRCC, OCEP)
- 3) Are you male or female?
☐ Male ☐ Female
- 4) How old are you? _____ years
- 5) Have you had previous prescribing experience? eg. Optometrist, dentist
☐ Yes ☐ No
- 6) When taking a medicine history how often would you ask about
Prescription drugs	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Over the counter/ non-prescription drugs	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Complementary/herbal	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Vaccinations	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Adverse drug reactions	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Adherence to therapy	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Drug allergies	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
Medications recently ceased or changed	☐ Always	☐ Sometimes	☐ Rarely	☐ Never
- 7) What sources would you recommend to patients/use yourself for information about medicines? (please tick all that apply)
Patient Information Leaflets (PILs)	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Ask doctors	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Ask pharmacists	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Ask nurses	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Australian Medicines Handbook	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Therapeutics Guideline	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Australian Prescriber	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
MIMS	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Pharmaceutical Benefits Scheme	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
UptoDate	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Best Practice	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
National Prescribing Service	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Internet (please specify).....	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Drug company representative	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
- 8) How would you identify a potential adverse drug reaction (ADR) (please tick all that apply)?
☐ Patient reports ADR	☐ Abnormal laboratory/blood results
☐ Stop/reduce drug & reaction disappears	☐ Rechallenge and reaction reappears
☐ Check literature to verify ADR	☐ Ask pharmacist for advice
☐ Consult with regulatory agencies	☐ Personal experience of doctor
☐ Consider amount of drug used (dose response)	☐ Time course consistent for ADR
☐ Alternative causes considered unlikely	☐ Other (please specify).....
- 9) How would you report an ADR (please tick all that apply)?
☐ Report to superior	☐ Report to nurse	☐ Write in discharge summary
☐ Write in case notes	☐ Write on alert sheet	☐ Contact clinical pharmacist
☐ Write on drug chart	☐ Blue ADRAC form	☐ Email/phone TGA
☐ Write on patient ADR alert card	☐ MIMS online	☐ Online Australian Adverse Drug Reaction Reporting System
☐ Other (please specify).....		
- 10) How important do you think the following factors are when individualizing medical treatment?
	Very Important	Important	Fairly Important	Not Important
Age	☐	☐	☐	☐
Gender	☐	☐	☐	☐
Renal function	☐	☐	☐	☐
Liver function	☐	☐	☐	☐
Cardiovascular disease	☐	☐	☐	☐
Gastroenterological disease	☐	☐	☐	☐
Body mass	☐	☐	☐	☐
Concurrent medications	☐	☐	☐	☐

(Continued)

Figure 1. (Continued)

Race	☐	☐	☐	☐
Genetics	☐	☐	☐	☐
Patient compliance	☐	☐	☐	☐
Patient level of understanding	☐	☐	☐	☐
Cost of medication	☐	☐	☐	☐

11) You are in clinic and see a 40-year old man, 70kg with epilepsy receiving a stable dose of phenytoin of 300mg/day. He has had no seizures for two years and has no other health problems. You decide to measure his plasma phenytoin concentration and results come back as 23mg/L (normal: 10-20). Assuming the sample was taken and analysed correctly what would you do?

☐ Reduce phenytoin dose
☐ Continue current dose
☐ Reduce dose & start another anti-epileptic agent
☐ Admit to hospital

12) How do you rate your pharmacology skills after graduating/about to graduate from medical school?
 (skills include: taking medicines history, prescribing, calculating appropriate doses, evaluating medicines, monitoring drugs, detecting ADRs, accessing reliable information)

☐ Extremely well prepared ☐ Well prepared ☐ Fairly well prepared ☐ Not prepared

13) Comments on clinical pharmacology teaching

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Figure 1. Test questionnaire.

Table 2. Objective competency.

	Drug monitoring <i>n</i> [%]	Identify ADR <i>n</i> [%]	Report ADR <i>n</i> [%]
All subjects	38/58 (65.5)	21/58 (36.2)	6/58 (10.3)
Gender			
Male	16/24 (66.7)	9/24 (37.5)	1/24 (4.2)
Female	22/34 (64.7)	12/34 (35.3)	5/34 (14.7)
Training location			
Urban	15/22 (68.2)	6/22 (27.3)	0/22 (0.0)
Rural	23/36 (63.9)	15/36 (41.7)	6/36 (16.7)
Age			
<28 years	20/33 (60.6)	11/33 (33.3)	4/33 (12.1)
≥28 years	17/24 (70.8)	10/24 (41.7)	2/24 (8.3)
Self-reported competency			
'Prepared'	20/29 (69.0)	12/29 (41.4)	3/29 (10.3)
'Not prepared'	18/29 (62.1)	9/29 (31.0)	3/29 (10.3)

ADR: Adverse drug reaction.

($p=0.08$ for concordance indicating poor agreement with subjective competency). Overall, 21 (36.2%) had the skills to correctly identify ADRs. A total of 12 considered themselves as being 'fairly well prepared' or 'well prepared'. Of the 37 subjects who did not achieve competency, 20 considered themselves as 'not well prepared'

($p=0.12$ for concordance indicating poor agreement with subjective competency). Relatively few students ($n=6$, 10.3%) had the necessary skills to report an ADR. Each of these students trained in rural settings during their penultimate year in the medical school. Of the 6 subjects who demonstrated competency, 3 considered themselves

Table 3. Ascertainment of patient medication history.

	Prescription medications <i>n</i> (%)	Non-prescription medications <i>n</i> (%)	Complementary medicines	Adverse drug reaction <i>n</i> (%)	Adherence to therapy <i>n</i> (%)
Always	56 (96.6)	30 (51.7)	19 (32.8)	45 (77.6)	6 (10.3)
Sometimes	2 (3.4)	26 (44.8)	30 (51.7)	7 (12.1)	29 (50.0)
Rarely	0 (0.0)	1 (1.7)	7 (12.1)	4 (6.9)	20 (34.5)
Never	0 (0.0)	1 (1.7)	2 (3.4)	2 (3.4)	3 (5.2)

as being ‘fairly well prepared’ or ‘well prepared’, and of the 52 subjects who did not achieve competency, 26 considered themselves as ‘not well prepared’ ($p < 0.001$ for concordance). Only three students had all the required skills to adequately take a medicines history. Students frequently asked about prescription and nonprescription medications but rarely inquired about adherence to treatment (Table 3). Of the 3 subjects who demonstrated full competency, 1 considered themselves as being ‘fairly well prepared’ or ‘well prepared’, and of the 55 subjects who did not achieve competency, 27 considered themselves as ‘not well prepared’ ($p < 0.001$ for concordance).

Our finding that only 50% of students reported feeling prepared in CP skills is similar to that observed among medical graduates in other countries with similar medical curriculums. At the end of their first year as a postgraduate doctor, 63% of doctors in the Birmingham and Worcester regions of the UK reported receiving adequate undergraduate training in CP [Baldwin *et al.* 2012]. In Aberdeen, 56% of first year doctors thought their undergraduate teaching had prepared them to prescribe safely and rationally [Tobaiqy *et al.* 2007]. Our study also provides objective competencies in detecting and reporting ADRs, which have been described elsewhere by graduates as being poorly taught. In the UK, inadequate teaching of ADRs was identified amongst 42% of first year doctors and 60% reported insufficient teaching about drug–drug interactions during their university education [Tobaiqy *et al.* 2007]. At Flinders University only second year medical students receive formal lectures on ADRs with most CP teaching occurring informally within rotations and problem based learning. The poor agreement between subjective and objective CP competency observed in our study is in line with previous reports among junior doctors and medical students in a number of areas including

prescribing medication [Ryan *et al.* 2013], skills in evidence based medicine [Lai and Teng, 2011] and clinical and procedural skills [Barnsley *et al.* 2004]. The mismatch between self-perceived and actual skill level has implications for student assessment, in particular the use and value of formative and self-assessment.

Our study has a number of limitations. First, the response rate was relatively low. There may have been a response bias with students who felt adequately prepared being more likely to respond than those that did not. However, this would have resulted in conservative estimates of the lack of subjective and objective competency. Second, the study may have lacked sufficient power to detect significant associations between demographics and objective levels of skill. Third, it was limited to one Australian university, meaning that the results cannot be generalised to other Australian medical schools or to students in other English speaking countries with similar curriculums. Larger studies designed to attract a better response rate and with more comprehensive assessment are required. Fourth, since the study was conducted midway through the final year of postgraduate medical studies, the results may underestimate the final competency achieved by the end of the year. Studies have shown that CP competency of junior doctors improves over time [Pearson *et al.* 2000; Harding *et al.* 2010]. However, it is unlikely that students would significantly improve their knowledge in the final 6 months of their course given the lack of formal CP teaching. The lack of a more comprehensive assessment of clinical pharmacology skills, particularly prescribing, did not allow a formal comparison with published studies. However, our preliminary results are an initial step for the development of local clinical pharmacology assessment methods as part of comprehensive assessment methods, e.g. the Objective Structured Clinical Examination (OSCE).

Conflict of interest statement

The authors declare no conflict of interest in preparing this article.

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