

Pharmacy students' understanding and perceptions around medication adherence

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Abstract

Background: Pharmacists can optimise patients' medication adherence, hence pharmacy students should be acquiring professional competence to ensure they are prepared for their future professional role. Pharmacy curricula need to carefully address the concept of adherence.

Aim: To investigate undergraduate pharmacy students' understanding and perceptions of medication adherence across the four years of the Pharmacy programme in an Australian school of pharmacy.

Method: Following piloting and ethical approval, a 20 statement electronic survey was distributed online to all undergraduate pharmacy students across four year levels. Students expressed their level of understanding and perceptions of 'medication adherence' on a 5-point Likert scale. The variation in mean responses across year levels and demographic groups was analysed using one-way ANOVA ($p < 0.05$).

Results: Of the 858 students, 20.4% completed the survey. Students did not have comprehensive understanding of adherence, even though the majority (61.14%) felt confident regarding their ability to understand its causative factors. A non-significant variation in student responses was observed across year levels. Students considered 'adherence education' to be important for future practice.

Conclusion: Students' understanding and perceptions around medication adherence did not vary significantly as they progressed through the degree. Suitable curriculum content around medication adherence could assist in optimising students' preparedness for practice.

Keywords: Adherence Education, Australia, Medication Adherence, Pharmacy, Students

Introduction

Medication non-adherence is a complex, multi-dimensional issue, resulting in increased morbidity, mortality and healthcare costs (Willey *et al.*, 2000; Brown *et al.*, 2011). It is an ongoing challenge in healthcare, with up to 50% of patients with chronic disease reported as non-adherent (Foreman *et al.*, 2012). Optimising medication adherence frequently requires a highly personalised approach because individual patients possess a unique interplay of factors that may influence their medication adherence (Barkhof *et al.*, 2012). For instance, these can be related to the patient (*e.g.* poor health literacy), prescriber (*e.g.* suboptimal communication), or healthcare system (*e.g.* high drug costs) (Brown *et al.*, 2011). Non-adherence can be broadly classified as either intentional or unintentional. While patients can demonstrate both types of non-adherence simultaneously, the factors underpinning them differ significantly (Mukhtar *et al.*, 2014). Intentional non-adherence occurs when a patient makes an active decision not to follow the prescribed treatment regimen, whereas unintentional non-adherence often arises due to patients' forgetfulness or confusion (Iihara *et al.*, 2014). Distinguishing between intentional and unintentional medication non-adherence is critical when considering

appropriate strategies to support adherence (Mukhtar *et al.*, 2014).

While numerous adherence-improving interventions have been trialled with varying degrees of success, no single intervention has consistently resolved non-adherence (Nieuwlaat *et al.*, 2014). These interventions should, ideally, incorporate a multifaceted approach addressing the emotional, cognitive and behavioural elements associated with non-adherence (Hedegaard *et al.*, 2016). There is still no universally guaranteed solution to non-adherence though health professionals play a key role in addressing it in practice (Cutrona *et al.*, 2010; Spoelstra *et al.*, 2016) with pharmacists having been shown to be able to improve medication adherence (Pringle *et al.*, 2014; Gupta *et al.*, 2015; Saleem *et al.*, 2015; Wang *et al.*, 2015; Hedegaard *et al.*, 2016; Nguyen *et al.*, 2016). This reflects the consumers' perceptions of pharmacists as highly accessible and trusted health professionals with expert medication knowledge, well placed to address medication non-adherence (Gupta *et al.*, 2015). With evidence demonstrating pharmacists' role in improving adherence, it is essential they are equipped with the knowledge and strategies to effectively fulfil this role in practice (Boyko *et al.*, 2011).

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Pharmacists' ability to identify and address non-adherence requires exposure to education about medication adherence at an undergraduate level (Rickles *et al.*, 2012). Therefore, ensuring the pharmacy curriculum is structured to provide students with the knowledge and skills to identify and manage non-adherence is vital to effectively address this widespread healthcare concern.

Medication adherence is widely researched, however, the literature about this topic within the pharmacy education context is limited. One study that did examine this was conducted by Rickles *et al.* who investigated the extent and nature of the topic of medication adherence within the United States [US] pharmacy curricula (Rickles *et al.*, 2012). Although this study examined students' perceptions of medication adherence, it was solely focused on determining the level of student exposure to medication adherence related concepts, without examining their understanding of these concepts. Another study collected information on teaching of adherence in the Australian pharmacy schools' curricula, including information on adherence, strategies to optimise adherence, and models of non-adherence (Aslani *et al.*, 2009).

Currently, there is varied 'adherence content' across the four year levels in the Bachelor of Pharmacy [B.Pharm.] programme at The University of Queensland [UQ]. For example, in 2016, a lecture on medication adherence was incorporated into both second year and fourth year courses. The second year lecture introduces adherence in the context of health behaviours, whilst the fourth year lecture focuses more on how to interpret these behaviours to implement adherence support strategies. Second year students also complete a Social Pharmacy course which "*demonstrates the links between individuals and issues related to health and illness by exploring the manner in which cultural, social and political factors influence health outcomes*" (The University of Queensland, 2016: online), which may also indirectly address medication adherence.

Gaining insight into pharmacy students' understanding and perceptions of medication adherence is vital to ensure they have the knowledge and skills to provide suitable support to their patients. The aim of this study was to investigate undergraduate pharmacy students' understanding and perceptions of medication adherence across the four years of the Pharmacy programme in the context of practice and education, while determining if their understanding aligns with current evidence. This study offers insights into an undergraduate student cohort's understanding of a complex healthcare behaviour and this will inform optimisation of the medication adherence component of the pharmacy curriculum.

Methods

An online survey consisting of 20 statements designed to examine students' understanding and perception of

Table I: Medication Adherence Survey Statements

Theme 1 – Factors influencing medication adherence
3. Consumer medicine information (CMI) leaflets do not meet all of the patient's information needs (Haynes <i>et al.</i> , 1999; Julius <i>et al.</i> , 2009; Ryan <i>et al.</i> , 2014)
9. Patients are adherent if the consequences of non-adherence are likely to cause pain, discomfort or decrease their quality of life (e.g. people with epilepsy suffer seizures when non-adherent so they will have good adherence) (Briesacher <i>et al.</i> , 2008; Burkhardt <i>et al.</i> , 2003)
10. If a patient is educated on the benefits of their medication, he/she will be adherent (Burkhardt <i>et al.</i> , 2003)
12. The outcome of adherence improving strategies is independent of patient age (Burkhardt <i>et al.</i> , 2003)
13. Male patients are less likely to be adherent in comparison to female patients (Burkhardt <i>et al.</i> , 2003)
14. Female patients are less likely to be adherent in comparison to male patients. (Burkhardt <i>et al.</i> , 2003)
Theme 2 – Resolution of the causes of non-adherence
2. Simplifying a complex medication regimen (e.g. reducing the number of medications) solves medication non adherence (Haynes <i>et al.</i> , 1999; Julius <i>et al.</i> , 2009; Ryan <i>et al.</i> , 2014)
4. Adherence with medication is likely to be optimal if the treatment tailors to the patient's individual routine, needs, expectations and preferences (Ryan <i>et al.</i> , 2014)
5. Health professionals providing clear and sufficient medication information solves the patient's eventual problems with non-adherence (Haynes <i>et al.</i> , 1999; Julius <i>et al.</i> , 2009; Ryan <i>et al.</i> , 2014)
6. If some adherence-improving strategies work really well for some patients, they are likely to also work for most patients (Ryan <i>et al.</i> , 2014)
8. Adherence-improving strategies are more effective at increasing adherence in short-term medication regimens (e.g. antibiotics) than treatment for chronic (long-term) conditions (e.g. blood pressure medication) (Burkhardt <i>et al.</i> , 2003; Osterberg <i>et al.</i> , 2005)
11. Adherence improving strategies are more likely to work in older patients (>60yrs) than they are for younger patients (Burkhardt <i>et al.</i> , 2003)
Theme 3 – Relevance of 'medication adherence' as a topic in the pharmacy curriculum and for future pharmacy health professionals
1. Ensuring the patient takes his/her medications as prescribed is the responsibility of the pharmacist
7. It is common for patients not to use their medication as prescribed
15. Lectures and tutorials should have a greater focus on the topic of medication adherence.
16. Strategies to identify medication non-adherence should be a taught during placements.
17. "Medication adherence" is a simple concept which does not require greater teaching focus.
18. I am confident in my ability to understand the factors causing non-adherence in practice.
19. Being able to identify non-adherence is an essential skill for me as a future pharmacist.
20. Introducing assessment around addressing medication non-adherence to the pharmacy curriculum would increase my knowledge of medication adherence.

'medication adherence' was distributed to students enrolled in the B.Pharm. programme at UQ. The survey statements addressed three main themes: 1) factors influencing medication adherence; 2) resolution of the causes of non-adherence; and 3) the relevance of 'medication adherence' as a topic in the pharmacy curriculum and for pharmacy practice. The three themes were developed through searching Cochrane, PubMed and UQ Library online databases for relevant literature published between 1996 and 2016. Concepts considered

essential for students' understanding of medication adherence were developed into survey statements and classified into themes. The three researchers reached agreement regarding the development and thematic classification of the statements. Survey statements and literature used to develop these are listed in Table I.

Participants indicated a level of agreement to statements on a 5-point Likert scale (Chandler *et al.*, 2011) ranging from 1 (strongly disagree) to 5 (strongly agree), with a middle value of 3 indicating students were undecided. This psychometric scale denoted trends towards disagreement (lower scores) or agreement (higher scores) for each attitude statement. The completed survey was uploaded into an online survey tool, Checkbox® (Checkbox Survey, 2016). Demographic data was collected (Table II) and participants were also provided the option to submit additional, open comments at the end of the survey. The survey instrument was initially piloted with ten pharmacy students across the four year levels and their feedback informed minor survey modifications. Their responses were not included in the survey results. Prior to releasing the survey, ethics approval (Ref 2016/4) was granted from UQ School of Pharmacy Ethics Committee, in accordance with The National Health and Medical Research Council's guidelines.

A convenience sample consisted of 858 undergraduate students from first to fourth year of the B.Pharm. programme at UQ. The students were invited to participate through posting an announcement with a link

to the survey on the University Blackboard® website. The survey was available for five months (May-September 2016) and ways to maximise the response rate included regular classroom, email, and year level website announcements. Participation was anonymous and voluntary, with students completing the survey outside of class time. Consent was obtained via an online consent form that participants agreed to prior to commencing the survey.

Data Analysis

Upon closing the survey, data were collected from Checkbox® and imported into Microsoft Excel®. Demographic data were analysed using descriptive statistics. Mean responses to statements were calculated to reflect an overall level of agreement or disagreement to each statement for each year level. Variation in responses between year levels and demographic groups was analysed using one-way ANOVA ($p < 0.05$) with GraphPad Prism® v.7 (GraphPad Software, 2016).

The combined student responses (Years 1 - 4) were considered 'correct' if they 'agreed' or 'strongly agreed' to statements that were supported by literature (S3, S4, S12). Several incorrect statements, were also included in the survey, therefore for these statements, a student response of 'disagree' or 'strongly disagree' was considered as correct (S2, S5, S6, S8 – S11, S13, S14). Statements on student perceptions (S1, S7, S15-S20) were not classified as either 'correct' or 'incorrect'.

Table II: Demographic data of respondents (B.Pharm. pharmacy students)

Pharmacy Student	Year 1 (n=27)	Year 2 (n=51)	Year 3 (n=56)	Year 4 (n=41)	All 4 Years (n=175)
Gender					
Male	11 (40.74%)	16 (31.37%)	16 (28.57%)	13 (31.71%)	56 (32%)
Female	16 (59.26%)	35 (68.63%)	40 (71.43%)	28 (68.29%)	119 (68%)
Age Group					
17-21	19 (70.37%)	28 (54.90%)	32 (57.14%)	26 (63.41%)	105 (60%)
22-30	6 (22.22%)	22(43.14%)	20 (35.71%)	15 (36.59%)	63 (36%)
>30	2 (7.41%)	1 (1.96%)	4 (7.14%)	0 (0%)	7 (4%)
Major (Honours)					
Yes	11 (40.74%)	22 (43.14%)	22 (39.29%)	14 (34.15%)	69 (39.43%)
No	16 (59.26%)	29 (56.86%)	34 (60.71%)	27 (65.85%)	106 (60.57%)
Student					
Domestic	19 (70.37%)	37 (72.55%)	35 (62.50%)	24 (58.54%)	115 (65.71%)
International	8 (29.63%)	14 (27.45%)	21 (37.50%)	17 (41.46%)	60 (34.29%)
Language spoken at home					
English	23 (85.19%)	39 (76.47%)	37 (66.07%)	25 (60.98%)	124 (70.86%)
Other	4 (14.81%)	12 (23.53%)	19 (33.93%)	16 (39.02%)	51 (29.14%)
Intend to work as a Pharmacist after graduating?					
Yes	24 (88.89%)	50 (98.04%)	53 (94.64%)	36 (87.80%)	163 (93.14%)
No	3 (11.11%)	1 (1.96%)	3 (5.36%)	5 (12.20%)	12 (6.86%)
Currently employed in pharmacy?					
Community	4 (14.81%)	30 (58.82%)	22 (39.29%)	12 (29.27%)	68 (38.86%)
Hospital	1 (3.70%)	8 (15.69%)	4 (7.14%)	3 (7.32%)	16 (9.14%)
No	22 (81.48%)	13 (25.49%)	30 (53.57%)	26 (63.41%)	91 (52%)
B.Pharm. first degree?					
Yes	21 (77.78%)	45 (88.24%)	46 (82.14%)	39 (95.12%)	151 (86.29%)
No	6 (22.22%)	6 (11.76%)	10 (17.86%)	2 (4.88%)	24 (13.71%)

Results

The overall response rate was 20.4% since a total of 175 (Years 1 - 4) of the 858 students completed the survey questionnaire; 27 first year students (15.43%), 51 second year students (29.14%), 56 third year students (32%), and 41 fourth year students (23.43%). All responses were complete and there was no missing data. The gender proportion of respondents was 32% male and 68% female (Table II)

No significant differences were noted in mean responses across the year levels, or between the demographic groups (Table III). Open response data was not analysed because student comments did not address the survey content and, instead, offered a few ideas about the survey structure.

Table III: B.Pharm. students’ mean responses to survey statements

Survey Statement	Year 1		Year 2		Year 3		Year 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	3.889	0.8473	3.863	0.8949	3.625	1.121	3.683	0.9602
2	2.185	1.21	2.216	1.316	2.268	1.243	2.439	1.141
3	3.407	1.01	3.588	1.219	3.304	1.008	3.195	1.077
4	4.556	0.5064	4.725	0.6657	4.536	0.7854	4.341	0.9113
5	3.333	1.074	3.14	0.9899	3.214	1.039	3.317	1.083
6	2.808	1.021	2.863	0.9802	2.6	0.9149	2.732	1.073
7	3.815	1.111	4.137	1	3.804	1.086	3.875	0.853
8	3.111	1.086	2.765	1.142	2.839	0.9492	3.244	1.179
9	4.148	0.9074	4.06	0.9127	4.018	1.168	3.854	1.131
10	3.481	1.156	3.255	1.093	3.304	1.008	3.195	1.167
11	2.519	0.9352	2.373	0.8935	2.661	0.9	2.683	0.8197
12	2.889	1.05	3.157	1.173	3.143	1.135	3.098	1.221
13	3.074	1.107	2.863	1.077	3.286	0.9286	3.073	1.01
14	2.148	0.7181	2.235	0.8388	2.321	0.8114	2.512	0.8403
15	3.111	0.8006	3.333	0.9092	3.304	0.8928	3.293	0.9809
16	3.667	0.8771	3.98	0.7613	3.911	0.6682	3.976	0.6515
17	2.148	1.099	2.294	0.9858	2.089	0.7926	2.39	1.046
18	3.333	1	3.48	0.9669	3.571	1.024	3.634	0.7334
19	4.37	0.8389	4.608	0.6951	4.429	0.735	4.512	0.6373
20	3.333	1.144	3.51	1.027	3.643	0.9031	3.561	1.05

Students understanding of medication adherence was examined in 12 of the 20 survey statements. These statements focussed on two main areas: the resolution of non-adherence (Figure 1a) and factors influencing medication adherence (Figure 1b).

Figure 1a: Student responses (Year 1 - 4) to knowledge statements (resolution of non-adherence)

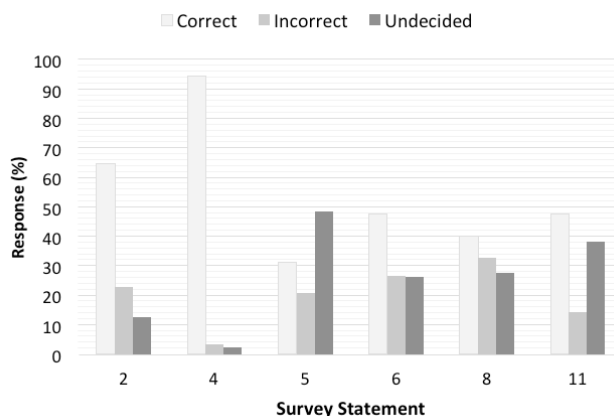
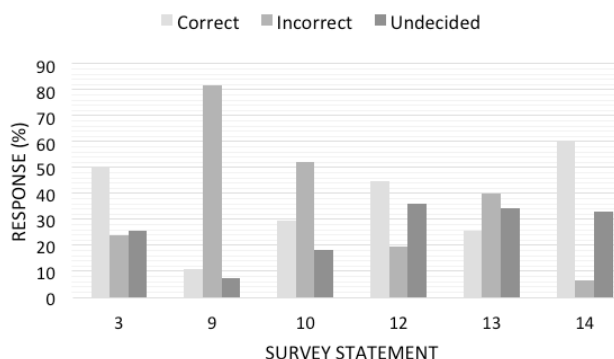


Figure1b: Student responses (Year 1 - 4) to knowledge statements (factors influencing medication adherence)



Understanding of factors influencing medication adherence

A total of six statements (S3, S9-S10, S12-S14) were designed to examine students’ understanding of factors influencing medication adherence.

There were a higher number of correct responses recorded for S3 (50.29%), which examined the role of written information, S12 (44.57%), which related to the relationship between patient age and adherence, and S14 (60.57%) that looked at adherence in relation to gender. If incorrect and undecided responses are combined, the correct responses make up the majority in only two (S3, S14) of the six statements relating to factors influencing adherence.

Over half of students were correct to disagree that female patients are less likely to be adherent in comparison to male patients (S14). However, only 25.71% of students were correct to disagree that male patients are less likely to be adherent in comparison to female patients (S13) with 40% believing male patients were more likely to be non-adherent. Approximately one third of students stated they were uncertain for both statements.

Incorrect responses made up the highest proportion of total responses for S9, S10, and S13. These statements related to the influence of poor health consequences, patient education and gender, on adherence, respectively.

Understanding of resolution of the causes of non-adherence

Students' understanding of resolution of non-adherence was examined through six survey statements (S2, S4-S6, S8, S11)

There were 94.29% of students who answered either 'agreed' or 'strongly agreed' to S4 and a higher proportion of correct responses were also recorded for S2, S6, S8, and S11 related to the effectiveness of simplifying medication regimens, using the same adherence strategy in multiple patients, interventions in acute vs. chronic treatment, and interventions in older patients. After combining incorrect and undecided responses though, correct responses made up the majority in only two, (S2, S4) of the six 'resolution knowledge' statements.

The statement that examined the role of verbal information in adherence management (S5) had the highest proportion of uncertainty with a response of 'undecided' submitted by 48.28% of participants, with only just under one third of respondents answering correctly (disagreement) to this statement and one fifth recording an incorrect response (agreement).

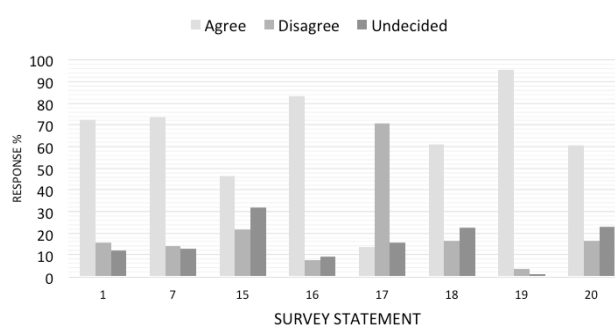
Perceptions on the relevance of medication adherence

Student responses to statements examining perceptions of medication adherence and its relevance as a topic in the pharmacy curriculum and for future professional practice (S1, S7, S15-S20, Figure 2) revealed that the majority expressed agreement to seven of the eight perception statements (S1, S7, S15-S16, S18-S20). The highest level of agreement was recorded for S19, 'being able to identify non-adherence is an essential skill for me as a future pharmacist' with 95.42% of students either 'agreeing' or 'strongly agreeing'. Almost 60% of students believed ensuring adherence was a pharmacist's professional responsibility (S1) and that it was common for patients to not take medication as prescribed (S7).

Responses to S15 and S16 indicate a high level of student agreement (83.43%) with the view that identifying strategies to address non-adherence should be taught during student placements (S16), with only around half of the respondents believing that lectures and tutorials should have a greater focus on the topic of medication adherence (S15).

Two thirds of students stated that they were confident in their ability to 'understand the factors causing non-adherence in practice' (S18). Despite this, all of these respondents recorded at least one incorrect or uncertain response for statements examining knowledge of factors causing non-adherence (S3, S9-S14). A high proportion of students disagreed that medication adherence was a simple concept and indicated that the topic required a greater teaching focus (S17).

Figure 2: Combined student responses (Year 1 - 4) to perception statements



Discussion

The results from this survey of pharmacy students suggested that they did not yet have clear knowledge on the factors influencing adherence, but could identify effective strategies to resolve non-adherence and acknowledge the importance of adherence within the curriculum and to them as future pharmacists. The authors found no improvement in understanding of adherence between the year levels. Second and fourth year students were exposed to adherence lectures and tutorials between March-June 2016, this overlapped with the months the survey was open (May-September 2016). Despite this, the results indicate that current exposure to the topic of medication adherence did not seem to be increasing students' knowledge. This suggests that optimisation of the pharmacy curriculum to revise the appropriateness and quality of current adherence related content, incorporating additional medication adherence education, is likely to benefit students. The gender proportion of respondents was similar to the Australian national averages for registered pharmacists (Pharmacy Board of Australia, 2016).

Understanding of factors influencing medication adherence

If pharmacy students are to fulfil one of their key roles, supporting medication adherence in their patients, it is essential that they can identify and understand factors influencing adherence. Without comprehensive adherence education, however, this may be challenging,

as these factors are often highly complex and patient specific (Barkhof *et al.*, 2012).

Students' responses suggested mixed perceptions towards the role of written and verbal information in adherence management. Many students were either unsure, or perceived that written and verbal information would independently optimise adherence. Evidence suggests that for some patients, adherence is optimised when a combination of written and verbal information is provided (Mai *et al.*, 2007; Borgsteede *et al.*, 2011). Students also need to be aware, however, that providing information may in some cases result in non-adherence. Informing certain patients on adverse effects can negatively influence attitudes towards medication which can result in non-adherence (Borgsteede *et al.*, 2011). Therefore, students should understand that the extent and format of information provision should be guided by patient preference and that neither written nor verbal information can independently ensure adherence in all patients.

Over half of students believed that if a patient is educated on the benefits of medication, they will be adherent, however evidence suggests that knowledge alone cannot successfully improve adherence as both behavioural and psychological factors must also be addressed (Burkhart *et al.*, 2003). For some patients with unintentional non-adherence (*e.g.* forgetfulness), these factors are less likely to impact on their medication adherence, (Hugtenburg *et al.*, 2013) and students who believed that education on the benefits of medication will improve adherence may have a poor understanding of unintentional non-adherence. Improving students' understanding of the differences between factors influencing intentional and unintentional non-adherence, and the associated implications, would be an issue to address through education.

In addition, the majority of students assumed that patients are adherent when their non-adherence is likely to cause pain, discomfort or decrease their quality of life, which has been found to be untrue since patients often exhibit high levels of non-adherence even if this leads to major inconvenience (Mitchell *et al.*, 2000; Burkhart *et al.*, 2003).

Statements examining the influence of demographic factors on adherence (S13, S14) were generally not answered correctly. Overall, many students believed patients' gender influences adherence, with females more likely to be adherent, however multiple studies have found males to be more adherent (Lewey *et al.*, 2013; Manteuffel *et al.*, 2014) and others report there is no significant difference in adherence between gender (Geisel-Marbaise *et al.*, 2010; Agh *et al.*, 2011). This contrast in results from the literature suggests that gender is not a strong predictor of adherence (Manteuffel *et al.*, 2014). Belief that gender consistently predicts adherence could potentially cause practice challenges since future pharmacists may focus less on addressing factors associated with non-adherence simply due to patient gender. Students should be educated to avoid focusing on

patient gender and to consider all the factors linked to poor adherence (*e.g.* complexity of drug regimen, high risk of adverse effects, poor health literacy).

Understanding of resolution of the causes of non-adherence

Resolving non-adherence is often extremely challenging and complex due to the wide range of patient specific factors influencing adherence (Barkhof *et al.*, 2012).

The majority of students correctly identified that simplifying a medication regimen does not necessarily solve non-adherence and agreed that adherence is most likely to be optimal when treatment is tailored to patient routine, needs, expectations and preferences (Haynes *et al.*, 1996). These responses showed that students, to some extent, understood that improving adherence requires a patient specific approach however, because students were unable to consistently apply this understanding to correctly answer the majority of survey statements, this understanding is likely superficial. This indicates students may need to develop a deeper understanding before they are able to effectively address non-adherence in practice. This was further reflected in that the majority of students did not understand that if an adherence improving strategy is effective in one patient, this does not necessarily indicate success in most patients. Students should be aware that there is currently no intervention which consistently improves adherence in all patients or conditions (Burkhart *et al.*, 2003).

Less than half of students correctly identified that the effectiveness of interventions is generally independent of patient age. Non-adherence is prevalent in elderly patients due to the increased likelihood of multiple medications, complex regimens, forgetfulness and an increased risk of adverse effects (Hughes, 2004), however this does not suggest that all interventions are less effective in this population. Instead, evidence suggests that there should be a greater focus on developing complex, tailored interventions for older patients on long term treatment as simple interventions which are often successful for improving adherence to acute treatment are less effective (Oliveira *et al.*, 2014).

Pharmacy education should encourage students to address non-adherence from medical, psychological and behavioural perspectives. Students should be aware that adherence interventions can be equally as effective in older patients if effort is made to ensure the intervention is tailored to the individual (Burkhart *et al.*, 2003). Pharmacy curricula should provide students with insights into interventions that consider individual patient factors for non-adherence.

While optimising adherence education does not guarantee pharmacists will have the ability to improve adherence in all patients, ensuring pharmacists have a comprehensive understanding of the complexities of medication adherence may enable them to address this issue in an informed manner which is likely to be reflected in optimised patient adherence.

Perceptions on the relevance of medication adherence

Students expressed a high level of agreement to statements examining perceptions of the relevance of non-adherence in their future professional practice. Students recognised that medication non-adherence is a widespread healthcare problem and also understood the important role pharmacists can play in assisting to resolve this.

Although students believed addressing non-adherence is essential in their future professional practice, fulfilling this role may prove challenging unless adequate training is incorporated into the undergraduate pharmacy curriculum. Most students supported the idea of incorporating adherence related education into student placements, however less than half believed that lectures and tutorials should have a greater focus on medication adherence and around 30% of students were undecided. This suggests that students may prefer medication adherence education to be provided in a practical setting or may already consider adherence is adequately covered in their pharmacy education. As medication non-adherence is a complex human behaviour, providing students with practical, real life, exposure could be highly beneficial and an area of focus if considering curriculum optimisation.

Approximately 70% of pharmacy students believed that medication adherence is a complex topic requiring greater teaching focus. A study conducted by Rickles *et al.* examining students' exposure to adherence concepts in US pharmacy curricula, however, reported that the majority of students believed adherence education was adequately covered. This demonstrates how the extent of student perceptions as well as their exposure to adherence education can vary between pharmacy institutions.

The majority of students agreed that introducing assessment around medication non-adherence would increase their understanding. This response aligns with current evidence that assessment can strongly influence student learning and academic outcomes (Adams *et al.*, 2013). Introducing medication adherence related assessment would create opportunities for students to further optimise their knowledge of adherence, which may assist in managing this issue in future practice.

The opportunity to obtain data on perceptions and understanding of medication adherence from a cohort of pharmacy students enrolled in the same programme was invaluable. Previous studies of the concept of medication adherence within the tertiary education context have collected students' perceptions regarding their overall exposure to medication adherence topics (Aslani *et al.*, 2009; Rickles *et al.*, 2012), and their perceptions of barriers to medication adherence counselling (Mangan *et al.*, 2013). These studies however, did not examine students' understanding of the concept. Data from this study **integrate** understanding and perception which can assist future curriculum optimisation. The topic of adherence requires more attention across all four year levels, and evaluation of a standardised curriculum

accommodating this would be a welcome addition. Teaching (and assessment) approaches need to acknowledge and include the multifaceted, complex concepts that govern this human behaviour, including its causes, the related practice challenges, and the known consequences of non-adherence.

Study Limitations

The main limitation of this study was the relatively low, ungeneralisable proportion of student responses obtained from each year level. Overall, just over 20% of pharmacy students responded to the survey and the data collected showed a statistically non-significant variation in responses between the four year levels. A greater number of responses may have either demonstrated variation in responses, or confirmed with greater certainty a non-significant variation. Focussing solely on pharmacy students at UQ was another limitation of the study. Although Australian pharmacy education is directed by an indicative curriculum (Stupans *et al.*, 2015), the extent and format of adherence-related content can vary between Australian universities. A study conducted by Aslani *et al.* found that although the majority of Australian pharmacy programmes incorporated adherence related education, the content, assessment requirements and years of adherence education were not consistent between programmes. This may result in varying levels of understanding of and perceptions around adherence between graduates from different Australian pharmacy programmes (Aslani *et al.*, 2009). In addition, pharmacy curricula are not standardised globally as the role pharmacists play in addressing adherence varies greatly between countries (Toklu *et al.*, 2013). Countries which view pharmacists solely as 'dispensers' may focus less on developing students' understanding of adherence and perceptions of its relevance in pharmacy education would likely vary from the data collected in this study.

Future Research

As students' understanding and perceptions are likely to vary between Australian and international university pharmacy cohorts, an area of future research could involve collecting similar data on pharmacy students enrolled at other Australian and international universities. In addition, examining pharmacy educators' and preceptors' perceptions of medication adherence education would be valuable. Effective integration of medication adherence education content into the pharmacy curriculum requires a collaborative input from students, educators and preceptors, hence views and knowledge base of all three groups should be considered by curriculum designers. Rickles *et al.* examined preceptors' opinions towards the extent that US pharmacy students were exposed to medication adherence related activities during placements. The results revealed preceptors believed students received inadequate exposure to these activities, mainly due to practice time constraints (Rickles *et al.*, 2012). Learning

about the perspectives of Australian preceptors and educators prior to integration of education on medication adherence into the pharmacy curriculum is likely to result in comprehensive curriculum optimisation.

Conclusion

Pharmacists play a key role in improving patient adherence, therefore it is essential that pharmacy curricula address development of students' knowledge and skills around the concept of medication adherence. Pharmacy students, in this instance, did not demonstrate comprehensive understanding of medication adherence and there was statistically non-significant variation in their adherence knowledge and perceptions across the four year levels. However, students recognised the importance of medication adherence education and its relevance in their future pharmacy practice. Optimising the pharmacy curriculum to incorporate a well designed, greater focus on medication adherence education may increase students' understanding and ensure they graduate with the knowledge, skills and professional attributes to effectively address non-adherence in future practice.

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