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Complete List of Authors:	Walpola, Ramesh; The University of Sydney, Faculty of Pharmacy Fois, Romano; The University of Sydney, Faculty of Pharmacy Carter, Stephen; The University of Sydney, Faculty of Pharmacy McLachlan, Andrew; University of Sydney, Faculty of Pharmacy; Concord Repatriation General Hospital, Centre for Education and Research on Aging Chen, Timothy; The University of Sydney, Faculty of Pharmacy
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Validation of a survey tool to assess the patient safety attitudes of pharmacy students

Ramesh L. Walpola[a], Romano A. Fois[a], Stephen R.Carter[a], Andrew J. McLachlan[a,b], Timothy F. Chen[a]

Ramesh L. Walpola[1]

BPharm

PhD Candidate

[a]Faculty of Pharmacy

The University of Sydney

New South Wales, Australia

Email: ramesh.walpola@sydney.edu.au

Romano A. Fois

BPharm PhD

Lecturer

[a]Faculty of Pharmacy

The University of Sydney

New South Wales, Australia

Email: romanof015@gmail.com

Stephen R. Carter

BPharm MSc PhD

Associate Lecturer

[a]Faculty of Pharmacy

The University of Sydney

New South Wales, Australia

Email: stephen.carter@sydney.edu.au

Andrew J. McLachlan

BPharm PhD

Professor of Pharmacy (Aged Care)

[a]Faculty of Pharmacy

The University of Sydney

New South Wales, Australia;

Chair of Pharmacy (Aged Care)

[b]Centre for Education and Research on Ageing

Concord Repatriation General Hospital

Concord, NSW, Australia

Email: andrew.mclachlan@sydney.edu.au

Timothy F. Chen

BPharm DipHPharm PhD

Associate Professor

[a]Faculty of Pharmacy

The University of Sydney

New South Wales, Australia

Email: timothy.chen@sydney.edu.au

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[1]Corresponding Author:

Ramesh Walpola

Faculty of Pharmacy

Bank Building (A15)

The University of Sydney

New South Wales, Australia

2006

Telephone: +61 2 9036 7081

Email: ramesh.walpola@sydney.edu.au

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Abstract

Objective: Patient safety education is a key strategy to minimise this harm, and is increasingly being introduced into junior pharmacy curricula. However, currently there is no valid and reliable survey tool to measure the patient safety attitudes of pharmacy students. This study aimed to validate a modified survey tool, originally developed by Madigosky et al., to evaluate patient safety attitudes of junior pharmacy students.

Design: A 23 item cross-sectional patient safety survey tool was utilised to evaluate first and second year pharmacy students' attitudes during May 2013 with both exploratory and confirmatory factor analyses performed to understand the psychometric properties of the survey tool and to establish construct validity.

Setting: Undergraduate university students in Sydney, Australia

Participants: 245 first year and 201 second year students enrolled in the Bachelor of Pharmacy Program at The University of Sydney, Australia in May 2013.

Results: After exploratory factor analysis on first year student responses (55.76% variance explained) and confirmatory factor analysis on second year responses, a 5-factor model consisting of 14 items was obtained with satisfactory model fit (χ^2 (66) = 112.83, p <.001, RMSEA =0.06, CFI = 0.91) and nesting between year groups ($\Delta\chi^2(7)$ = 3.079,p=0.8780). The 5 factors measured students' attitudes towards: (1) being quality improvement focused, (2) internalising errors regardless of harm, (3) value of contextual learning, (4) acceptability of questioning more senior healthcare professionals' behaviour and (5) attitude towards open disclosure.

Conclusion: This study has established the reliability and validity of a modified survey tool to evaluate patient safety attitudes of pharmacy students, with the potential for use in course development and evaluation.

Keywords (MeSH): Patient safety; education; pharmacy ; attitude; questionnaire

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Article Summary

Strengths and limitations of this study

- Patient safety is considered an essential part of pharmacist's vocational training however there is no validated tool published to measure pharmacy students' safety attitudes.

- This study validated a modified version of the most highly utilised survey tools to measure the patient safety attitudes of healthcare students in order to suit the requirements of junior pharmacy students.

- The large sample size obtained (N=446) allowed for a rigorous analytical approach to be undertaken, enabling both exploratory and confirmatory factor analyses to be performed with sufficient sample sizes for validation of the survey tool.

- The high response rates of students completing the survey (87.5% of first year students and 74.7% of second year students) means that the findings are likely to be representative of the attitudes of junior pharmacy students.

- Despite two of the factors consisting of only two items being a potential limitation of the short survey, the two items that loaded on these two factors adequately described the latent concepts being measured appropriate to the level of understanding and knowledge that junior pharmacy students have of the health care system.

Introduction

Patient safety has become a key priority for health systems around the world since the publication of the seminal reports *To Err is Human[1]* and *An Organisation with a Memory[2]* fifteen years ago. In 2002, World Health Organization (WHO) member states recognised the need to reduce the harm and suffering that patients and their families experience from healthcare errors, and agreed upon a resolution to improve patient safety. Education has since been considered a crucial element in minimising patient harm.[3] In 2011, the WHO published a multi-professional *Patient Safety Curriculum Guide*, derived from the Australian Patient Safety Education Framework, to assist healthcare schools to implement patient safety education.[4] However, the implementation of patient safety specific education can be challenging in already full university teaching curricula.[5]

Most pharmacy degree programs currently include education on some elements from the WHO curriculum including aspects related to medication safety, communication and patient centred care. It has been acknowledged that to improve the safety culture of healthcare organisations, students need to be able to recognise when they are working in unsafe conditions, how to manage working in unsafe conditions, be able to take a systems approach to the provision of healthcare, and to be able to manage errors and their causal factors, as well as the open disclosure of errors.[6,7] Considering that many students across healthcare disciplines, including pharmacy, are entering the health workforce at an earlier stage in their degrees, either through experiential placements or through casual employment, there is a greater need to instil patient safety knowledge from the commencement of their degrees and entry into the profession.[8,9]

In recognition of the increasing importance of patient safety education among pharmacy students, undergraduate students enrolled in the Bachelor of Pharmacy program at The University of Sydney, Australia, are now introduced to patient safety issues in the first year of their degree rather than in later years. There are a number of survey tools that measure patient safety attitudes and values of health care students, [6,10-15] with many of these tools based on the *Patient Safety/Medical Fallibility Survey* originally developed for medical students by Madigosky et al.[6] However, no survey tool has been validated to measure patient safety attitudes specifically among pharmacy students. Therefore, this study aimed to validate an adaptation of Madigosky et al.'s survey tool[6] in order to evaluate patient safety attitudes and values of junior pharmacy students, and specifically understand the psychometric properties that underpin the survey.

Methods

A cross-sectional survey was conducted among first (n=281) and second (n=269) year undergraduate pharmacy students enrolled in the four-year Bachelor of Pharmacy program at the University of Sydney. Data were collected between 27-31 May 2013, with approval to conduct this study granted by the Human Research Ethics Committee at the University of Sydney.

Survey

The survey tool was adapted from the *Patient Safety/Medical Fallibility Curriculum Survey* developed by Madigosky et al.[6] Specifically, survey items were modified to match first year Bachelor of Pharmacy students' level of knowledge and understanding of health care systems, resulting in the exclusion of skill and knowledge-based items from the original survey. The survey consisted of two sections: the first section contained the initial 22 attitudinal items of the *Patient Safety/Medical Fallibility Curriculum Survey*, as well as an attitudinal question to peer learning, and case studies to assess responses to scenarios; the second section collected demographic details including gender, age, stage of education, prior healthcare experience and involvement with an incident that resulted in harm or potential harm as a result of receiving healthcare.

A five-point Likert-type scale was used to measure student attitudes, with possible responses ranging from strongly disagree to strongly agree. The face validity of the survey instrument was assessed using a group of pharmacy students, academics and practising hospital and community pharmacists. Based on feedback from the group, definitions of "Patient Safety", "Error" and "Incident" as defined by the *Australian Commission for Safety and Quality in Healthcare* were included to assist students to complete the survey.

Analysis

All data analyses were completed using IBM SPSS Statistics version 21 (SPSS Inc., Chicago, IL) and AMOS version 21 (Amos Development Corporation, Crawfordville, FL). Participant characteristics were compared across year groups using Chi-square tests for categorical variables and Mann-Whitney and Kruskal-Wallis tests for continuous variables. In addition, the potential relationship between each of the participant demographic characteristics and their effects on survey responses were evaluated. A Bonferroni correction was applied to account for multiple comparisons, reducing the p-value for significance to 0.002.

An exploratory factor analysis (EFA) was performed on survey responses from the first year students to understand the latent structure underpinning student responses to the survey using maximum likelihood estimation and varimax rotation. As adequate sample sizes across both year groups were obtained, Kaisers criterion for factor retention was adopted with individual factors loading greater than 0.25 considered significant for retention.[16] The factor structure was assessed for a theoretical basis, with an examination of the Scree plot used to verify the number of factors retained.

The construct validity of the survey was evaluated using a confirmatory factor analysis (CFA) on the survey responses from the second year students. Each item was considered to have a latent construct and a measurement error, with both causal effects depicted by uni-directional arrows. Correlations between variables within the model were depicted using bi-directional arrows.[17] Maximum likelihood estimation was performed to calculate item loading. Items were removed from the model where there were: poor factor loading scores (being less than 0.25), insufficient number of items loading on the construct, or an insufficient theoretical basis to the construct after item removal.[16]

Boomsma's method of estimating a minimum sample size to conduct a CFA was performed based on the number of items to number of factors ratio of the model; it was estimated that 200 student responses would be adequate.[18] The goodness of fit of the model was evaluated using: Chi square to measure model parsimony, root mean-square error of approximation (RMSEA) to measure absolute fit, and the Comparative Fit Index (CFI) to evaluate the comparative fit.[19]

Results

Participant Characteristics

A total of 245 first-year and 201 second-year pharmacy students completed the survey, resulting in survey response rates of 87.5% and 74.7%, respectively. The characteristics of the first and second year students are compared in Table 1. There were very few differences in the characteristics between the two groups of students, with the only significant difference being the number of students engaged in current employment in a pharmacy (15.6% vs 44.4%, $p<0.001$) and mean months worked (2.4 vs 6.9, $p<0.001$). However, as most students that are engaged in employment in pharmacy are undertaking non-clinical roles (19.7% vs 8.6%), it is unlikely that current employment will influence junior students' responses to the survey questions.

Table 1 – Participant characteristics

Characteristic	First year students (n=245)	Second year students (n=201)	P-value
Gender: Males, *n* (%)* Females, *n* (%)*	 90 (36.9) 154 (63.1)	 65 (32.8) 132 (66.7)	 0.37
Age, in years, mean (SD)	19.4 (3.1)	20.0 (2.0)	<0.001
Students currently working in a pharmacy, *n* (%)*	38 (15.6)	88 (44.4)	<0.001
Months worked in pharmacy (mean, SD)	2.4 (9.5)	6.7 (11.9)	<0.001
Students who have been involved in or witnessed harm while working, *n* (%)*	21 (9.7)	29 (11.9)	0.06
Students who have witnessed harm to a loved one, *n* (%)*	35 (15.9)	35 (19.1)	0.14

*Note – percentages based on denominator of number of valid responses only

Comparisons of year group and other demographic characteristics with each of the survey items showed that demographic characteristics did not influence student responses after accounting for multiple comparisons with the Bonferroni correction (Appendix 1). However, two of the 23 attitudinal items which related to the inevitability of errors in healthcare and involving the patient in healthcare, showed statistical significance between year groups (p=0.001). Prior to the EFA, these items were removed as their exclusion was deemed not to have a significant impact on the model due to the inclusion of other survey items which measured similar concepts.

Exploratory Factor Analysis

Following the removal of 7 items, either due to low communalities (less than 0.2) or low factor loadings (less than 0.25) and examination of the Scree plot, a five factor solution was determined(Table 2). This solution explained 55.71% of the variance. Only one item cross-loaded and was assigned to a single factor based on theoretical reasoning. The five factors were labelled as being (1) quality improvement focused; (2) value of contextual learning; (3) internalising errors regardless of harm; (4) acceptability of questioning more senior healthcare professionals' behaviour and (5) attitude towards open disclosure of errors.

Table 2. Exploratory Factor Analysis (EFA) rotated factor structure

Question Number	Item	EFA Constructs					Cronbachs alpha if item deleted
		1 α=0.422	2 α=0.673	3 α=0.591	4 α=0.533	5 α=598	
Q7	Learning how to improve patient safety is an appropriate use of time in pharmacy programs at university.	0.62					0.22
Q3	Pharmacists should routinely spend part of their professional time working to improve patient care.	0.48					0.32
Q23	Peer-led education, such as from pharmacist colleagues or fellow students can help my understanding of patient safety concepts.	0.47					0.28
Q19	The care that we provide on a day to day basis could be improved.	0.47					0.37
Q5	Patients have a role to play in their own safety.	0.38					0.34
Q18	After an error occurs, an effective strategy is to work hard to be more careful.	-0.26					0.63
Q22	Patient safety education requires university lecturers to teach patient safety concepts.		-0.78				0.40
Q8	Healthcare professionals, including pharmacy staff, routinely share information about errors and what caused them.		0.76				0.54
Q6	The culture of the pharmacy workplace makes it easy for pharmacy staff to deal constructively with errors.		0.40				0.74
Q16	If I saw an error that DID NOT cause harm, I would keep it to myself			0.86			0.37
Q15	If I saw an error that DID cause harm, I would keep it to myself.			0.48			0.49

Q14	If there is no harm to a patient, there is no need to address an error.			0.42			0.58
Q10	Pharmacists should report errors to an affected patient and their family if harm to the patient has occurred.				0.97		-
Q11	Pharmacists should discuss and report errors to an affected patient and their family even if the patient is NOT harmed.				0.38		-
Q21	It is acceptable for a registered pharmacist to question the decisions of a prescriber (such as a doctor or nurse practitioner).					0.97	-
Q20	It is acceptable for an intern pharmacist to question the actions of a registered pharmacist.	0.34				0.36	-

Confirmatory Factor Analysis

In the second phase of the analysis, the construct validity of the instrument was established using CFA. After mapping the responses from the second year students to the suggested model determined by the EFA of first year students' responses, two items (Q5 and Q18) were removed due to low factor loading (less than 0.25), resulting in the final factor structure (Table 3). The Chi-squared values for overall model fit was significant, χ^2 (69) = 134.23, p <0.001, which suggested a significant misfit between the data and the model. However, it is known that in larger samples, the chi-squared value can be over-sensitive and other fit indices were assessed (RMSEA = 0.07 CFI=0.88), which suggested potential fit.[20] Modification indices suggested that freeing the covariance between two error terms in factor 1, and one error term in factor 3, as well as between one error term in factor 2 and one error term in factor 3, would improve model fit. A model including these specified correlations resulted in a subsequent model having better fit to the constrained model, χ^2 (66) = 112.83, p <0.001, RMSEA =0.06, CFI = 0.91. Utilising data from both first year students and second year students as part of a multi-group analysis, unconstrained nested model comparisons showed no significant difference in the unconstrained model between year groups ($\Delta\chi^2(7) = 3.079, p=0.878$). This indicates that both year groups satisfactorily fit the model. The combined data-set of first and second year student responses (N=446) was used to calculate the final factor loadings as seen in Figure 1.

[Insert Figure 1 here]

Table 3 – Final CFA Factor Structure

Explanation of factor structure:		Standardised regression weights	Unstandardized regression weights (URW)	Standard error of URW	Squared multiple correlations
Item number	**Item description**				
Factor 1: Being *quality improvement focused* (α=0.654)					
Q19	The care that we provide on a day to day basis could be improved.	0.40	1.00	0.39	0.16
Q3	Pharmacists should routinely spend part of their professional time working to improve patient care.	0.60	1.49	0.28	0.36
Q7	Learning how to improve patient safety is an appropriate use of time in pharmacy programs at university.	0.60	1.53	0.30	0.36
Q23	Peer-led education, such as from pharmacist colleagues or fellow students can help my understanding of patient safety concepts.	0.57	1.44	0.31	0.33
Factor 2: *Internalising errors* regardless of harm (α=0.705)					
Q16	If I saw an error that DID NOT cause harm, I would keep it to myself.	0.72	1.00	0.45	0.52
Q15	If I saw an error that DID cause harm, I would keep it to myself.	0.65	0.63	0.27	0.42
Q14	If there is no harm to a patient, there is no need to address an error.	0.53	0.63	0.49	0.28
Factor 3: Value of *contextual learning* (α=0.570)					
Q22	Patient safety education requires university lecturers to teach patient safety concepts.	0.95	1.00	0.06	0.90

Q8	Healthcare professionals, including pharmacy staff, routinely share information about errors and what caused them.	-0.59	-0.68	0.48	0.34
Q6	The culture of the pharmacy workplace makes it easy for pharmacy staff to deal constructively with errors.	-0.34	-0.35	0.51	0.12
Factor 4: Acceptability of *questioning* more senior healthcare professionals' *behaviour* (α=0.718)					
Q20	It is acceptable for an intern pharmacist to question the actions of a registered pharmacist.	0.64	1.00	0.31	0.40
Q21	It is acceptable for a registered pharmacist to question the decisions of a prescriber (such as a doctor or nurse practitioner).	0.77	1.00	0.14	0.60
Factor 5: Attitude towards *open disclosure* of errors (α=0.534)					
Q10	Pharmacists should report errors to an affected patient and their family if harm to the patient has occurred.	0.74	1.00	0.22	0.55
Q11	Pharmacists should discuss and report errors to an affected patient and their family even if the patient is NOT harmed.	0.53	1.00	0.71	0.28

Discussion

This study has validated a modified version of an existing patient safety attitudinal survey tool, the *Patient Safety/Medical Fallibility Curriculum survey,[6]* in pharmacy students. Given that the literature identifies a significant need to provide more training to pharmacy and other healthcare students on all aspects of patient safety, the use of this survey tool is crucial for evaluating the impact of these programs.[21-24] It is noteworthy that current patient safety programs for pharmacy students often include elements of identifying, understanding, reporting, managing and communicating risk. The underlying attitudes leading to the practice of these positive safety behaviours can all be evaluated using the survey tool.

A robust two-staged analytical method, involving EFA followed by CFA, was used to assess the reliability and validity of the survey tool. The results of these analyses demonstrated that the attitudes which underpin students' responses could be explained by five underlying dimensions: (1) being quality improvement focused, (2) internalising errors regardless of harm, (3) value of contextual learning, (4) acceptability of questioning more senior healthcare professionals' behaviour and (5) attitude towards open disclosure of errors. Four of these dimensions related to patient safety attitudes (Factors 1, 2, 4 & 5) and one pertained to the delivery of patient safety interventions (Factor 3). This survey tool can therefore be used to help assess the educational needs of students and evaluate patient safety educational interventions.[24]

The first factor pertained to willingness to undertake quality improvement activities. The EFA on first year students' responses revealed a relatively low internal consistency reliability for this factor (Cronbach alpha =0.422). Two items (Q5 – Patients have a role to play in their own safety and Q18 – After an error occurs, an effective strategy is to work hard to be more careful) had a relatively low loading on the factor and made little contribution to the meaning of the factor. After the removal of these items during the CFA process, there was a significant improvement in the Cronbach alpha in second year responses (0.654), thereby demonstrating improved internal consistency. This factor examined a positive attitude towards patient safety. Specifically this factor, focused on quality improvement as an indicator of positive safety culture, with higher scores indicating a greater emphasis towards taking a systems approach to dealing with errors, a desired outcome of many patient safety programs.[25] The second factor, however, measured a negative attitude toward patient safety. This factor related to managing and reporting risk, whereby students internalise the error rather than take action, regardless of whether the patient suffered harm. Thus higher scores

indicate that students may be less likely to appropriately manage an error. Scores on these factors are important given that there is a push towards teaching incident reporting from junior years to foster good behaviours and to develop a culture of understanding and preventing errors.[26] Consequently, as students become more quality improvement focused (as measured by factor 1), it would be expected that they would be more likely to appropriately manage an error rather than internalising the issue (resulting in a corresponding decrease in scores on factor 2).[27]

The fourth factor measured how acceptable it is to students to question the decisions of more senior healthcare professionals, an important part of managing risk in healthcare. Whilst the two items in this scale are clearly related, these two items do differ significantly. The first item in the factor relates to questioning the decision of a prescriber, whilst the second item relates to the questioning of an action of a more senior pharmacist. Previous studies have identified that a major obstacle to good patient safety practices among students is the hierarchical structure of healthcare organisations, including community pharmacies where most pharmacy students obtain their first clinical experience.[7,28] Being able to work well within teams has been associated with reduced medical errors and improved outcomes in primary healthcare.[29-31] In addition to effective communication, being able to deal with conflict, particularly with more senior healthcare practitioners, is also considered an important skill.[32] Many patient safety education programs now include training in managing situations resulting in conflict, and whilst this factor may not be able to directly examine this skill, by measuring students' attitudes, it indirectly evaluates whether there is a need for further training in this area.

A core element of all patient safety programs is the concept of patient-centred care, which includes involving the patient in decisions about their own care and openly disclosing incidents when they occur. Factor five related to open disclosure of errors and hence may be used as a measure of students' willingness to openly disclose errors to patients, regardless of whether or not harm occurs. Despite being uncommon in practice, open disclosure of errors by health care practitioners is desired by patients and required by healthcare authorities.[33] Furthermore, it has been shown that it is important for educators to commence open disclosure training as early as possible in order to have the greatest impact on changing this behaviour.[34]

The final factor (Factor 3) related to the educational delivery of patient safety interventions. It focused on the pedagogical method that would be most effective in delivering patient safety education to junior pharmacy students[24] with items relating to the didactic method of teaching

patient safety through university lectures, and learning from experience in the workplace. It is known that the learning preferences of students change throughout their degree, with more meaning-directed approaches preferred as they progress through their degree.[35] This factor may therefore be useful to guide the development of teaching materials, tailored to better suit students' learning style preferences.

Despite the survey being used previously in evaluating patient safety attitudes of both medical and nursing students, only one study has investigated the psychometric properties of the original survey.[12] Schnall et al.[12] utilised 17 of the skill and attitudinal items from the original survey to identify a nine item, three factor solution: "Error detection, time investment and creating a culture of safety". Five of the nine items included in Schnall's factor analysis were also included in our final CFA model, however, were placed under different factors in our analysis. Like Schnall et al., the present study observed low reliability scores in our factors during the EFA with first year students. However, when applying the EFA factor structure to our second year students, reliability scores increased, which indicates that students may understand and relate to survey items better the further they have progressed in their degrees as a result of receiving more practice-specific education.

Strengths and Limitations

This study has a number of strengths. Firstly, in the absence of a published survey tool to evaluate the patient safety attitudes of pharmacy students, this study modified one of the most highly utilised survey tools to measure the patient safety attitudes of healthcare students[6 10 12] in order to suit the requirements of junior pharmacy students. Furthermore, the relatively large sample size obtained (N=446) allowed for a rigorous analytical approach to be undertaken, enabling both EFA and CFA to be performed with sufficient sample sizes for validation of the survey tool. In addition, the high response rates of students completing the survey (87.5% of first year students and 74.7% of second year students) means that the findings are likely to be representative of the attitudes of junior pharmacy students undertaking the Bachelor of Pharmacy program at the University of Sydney. However, as the sample was drawn exclusively from a single institution, the findings may not be representative of students enrolled in other pharmacy programs. Finally, two of the factors (factor 4-questioning behaviours and factor 5-open disclosure) consisted of only two items. While this is considered acceptable,[36] it is also a potential limitation that is likely a consequence of the relatively short survey tool utilised. However, the two items that loaded on these two factors

adequately described the latent concepts being measured, and are appropriate to the level of understanding and knowledge that junior pharmacy students have of the health care system.

Conclusion

This study has demonstrated the validity of a tool to evaluate the attitudes of pharmacy students across a number of patient safety areas. Given that there is growing recognition of the need to educate pharmacy students in patient safety concepts; this survey can be used by pharmacy schools to evaluate the underlying dimensions of patient safety practices in order to tailor patient safety training to better suit students' educational needs.

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Competing Interests

None

Contributors

RW conceived and designed the study, delivered peer educator training, collected and analysed the data and drafted the manuscript. RF assisted in the design of the study, analysis of the results and revised the manuscript. SC assisted in the analysis of the results and revised the manuscript. AM and TC assisted in the design of the study and revised the manuscript.

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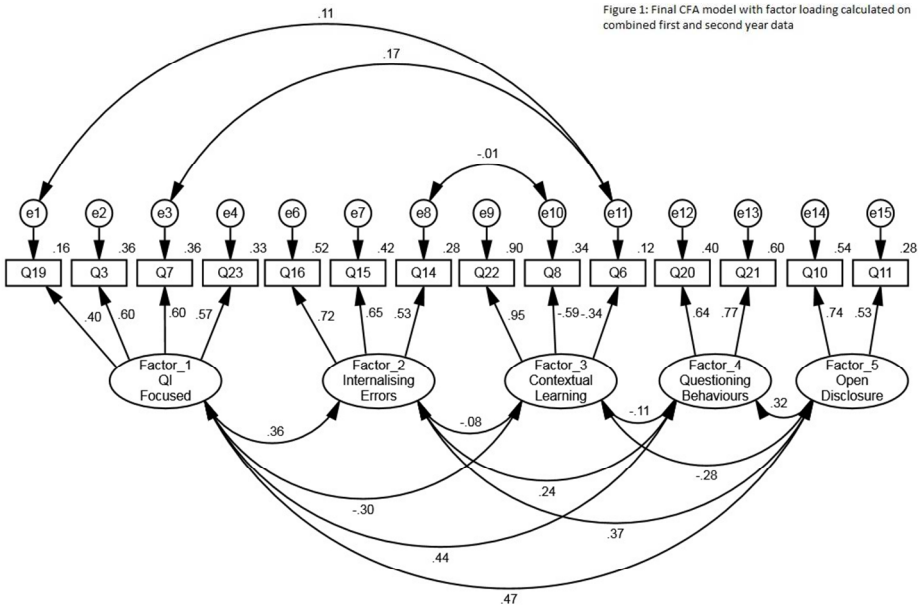

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Validation of a survey tool to assess the patient safety attitudes of pharmacy students

Appendix 1 – Factors that may affect students' responses

Question Number	Item	Effect of demographic detail on survey response (P – Value)*						
		Year Group	Gender	Age	Prior health experience	Current Pharmacy Employment	Witnessed harm at work	Witnessed harm to a loved one
Q1	Errors in healthcare are inevitable.	**0.001**	0.455	0.827	0.189	0.284	0.208	0.148
Q2	Competent health care professionals do not make errors that lead to patient harm.	0.765	0.232	0.861	0.167	0.686	0.113	0.601
Q3	Pharmacists should routinely spend part of their professional time working to improve patient care.	0.830	0.891	0.493	0.548	0.506	0.336	0.931
Q4	Only medical practitioners can determine the causes of a medical error.	0.215	0.437	0.253	0.090	0.188	0.091	0.087
Q5	Patients have a role to play in their own safety.	**0.001**	0.896	0.318	0.747	0.140	0.132	0.916
Q6	The culture of the pharmacy workplace makes it easy for pharmacy staff to deal constructively with errors.	0.578	0.450	0.584	0.302	0.398	0.620	0.855
Q7	Learning how to improve patient safety is an appropriate use of time in pharmacy programs at university.	0.664	0.221	0.051	0.926	0.378	0.168	0.169
Q8	Healthcare professionals, including pharmacy staff, routinely	0.794	0.662	0.097	0.428	0.723	0.208	0.747

	share information about errors and what caused them.							
Q9	In my experience, faculty and staff communicate to me that patient safety is a high priority.	0.807	0.900	0.478	0.249	0.782	0.273	0.290
Q10	Pharmacists should report errors to an affected patient and their family if harm to the patient has occurred.	0.135	0.280	0.394	0.098	0.624	0.573	0.083
Q11	Pharmacists should discuss and report errors to an affected patient and their family even if the patient is NOT harmed.	0.048	0.340	0.330	0.223	0.598	0.674	0.685
Q12	Effective responses to errors in the delivery of healthcare focus primarily on the healthcare professional involved	0.014	0.897	0.122	0.335	0.751	0.060	0.095
Q13	Disciplinary action against an individual who made an error is an effective method of preventing future errors.	0.762	0.612	0.777	0.921	0.423	0.723	0.855
Q14	If there is no harm to a patient, there is no need to address an error.	0.917	0.961	0.057	0.210	0.537	0.884	0.264
Q15	If I saw an error that DID cause harm, I would keep it to myself.	0.799	0.341	0.283	0.659	0.127	0.056	0.253
Q16	If I saw an error that DID NOT cause harm, I would keep it to myself.	0.416	0.678	0.232	0.038	0.237	0.555	0.989
Q17	Most errors are due to things that healthcare professionals can't do anything about.	0.423	0.499	0.260	0.925	0.472	0.727	0.128
Q18	After an error occurs, an effective strategy is to work hard to be	0.091	0.087	0.154	0.297	0.410	0.635	0.125

	more careful.							
Q19	The care that we provide on a day to day basis could be improved.	0.249	0.562	0.116	0.331	0.038	0.125	0.109
Q20	It is acceptable for an intern pharmacist to question the actions of a registered pharmacist.	0.183	0.0.34	0.471	0.207	0.983	0.849	0.473
Q21	It is acceptable for a registered pharmacist to question the decisions of a prescriber (such as a doctor or nurse practitioner).	0.864	0.276	0.856	0.491	0.477	0.252	0.703
Q22	Patient safety education requires university lecturers to teach patient safety concepts.	0.879	0.528	0.358	0.245	0.604	0.421	0.056
Q23	Peer-led education, such as from pharmacist colleagues or fellow students can help my understanding of patient safety concepts.	0.603	0.441	0.450	0.563	0.269	0.198	0.247

*Bonferroni Adjusted P-Value : 0.002

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Validation of a survey tool to assess the patient safety attitudes of pharmacy students

Ramesh L. Walpola[a], Romano A. Fois[a], Stephen R.Carter[a], Andrew J. McLachlan[a,b], Timothy F. Chen[a]

Ramesh L. Walpola[1]
BPharm
PhD Candidate
[a]Faculty of Pharmacy
The University of Sydney
New South Wales, Australia
Email: ramesh.walpola@sydney.edu.au

Romano A. Fois
BPharm PhD
Lecturer
[a]Faculty of Pharmacy
The University of Sydney
New South Wales, Australia
Email: romanof015@gmail.com

Stephen R. Carter
BPharm MSc PhD
Associate Lecturer
[a]Faculty of Pharmacy
The University of Sydney
New South Wales, Australia
Email: stephen.carter@sydney.edu.au

Andrew J. McLachlan
BPharm PhD
Professor of Pharmacy (Aged Care)
[a]Faculty of Pharmacy
The University of Sydney

New South Wales, Australia;

Chair of Pharmacy (Aged Care)

[b]Centre for Education and Research on Ageing

Concord Repatriation General Hospital

Concord, NSW, Australia

Email: andrew.mclachlan@sydney.edu.au

Timothy F. Chen

BPharm DipHPharm PhD

Associate Professor

[a]Faculty of Pharmacy

The University of Sydney

New South Wales, Australia

Email: timothy.chen@sydney.edu.au

_____

[1]Corresponding Author:

Ramesh Walpola

Faculty of Pharmacy

Bank Building (A15)

The University of Sydney

New South Wales, Australia

2006

Telephone: +61 2 9036 7081

Email: ramesh.walpola@sydney.edu.au

Validation of a survey tool to assess the patient safety attitudes of pharmacy students

Abstract

Objective: Patient safety education is a key strategy to minimise this harm, and is increasingly being introduced into junior pharmacy curricula. However, currently there is no valid and reliable survey tool to measure the patient safety attitudes of pharmacy students. This study aimed to validate a modified survey tool, originally developed by Madigosky et al., to evaluate patient safety attitudes of junior pharmacy students.

Design: A 23 item cross-sectional patient safety survey tool was utilised to evaluate first and second year pharmacy students' attitudes during May 2013 with both exploratory and confirmatory factor analyses performed to understand the psychometric properties of the survey tool and to establish construct validity.

Setting: Undergraduate university students in Sydney, Australia

Participants: 245 first year and 201 second year students enrolled in the Bachelor of Pharmacy Program at The University of Sydney, Australia in May 2013.

Results: After exploratory factor analysis on first year student responses (55.76% variance explained) and confirmatory factor analysis on second year responses, a 5-factor model consisting of 14 items was obtained with satisfactory model fit (χ^2 (66) = 112.83, p <.001, RMSEA =0.06, CFI = 0.91) and nesting between year groups ($\Delta\chi^2(7)$ = 3.079,p=0.8780). The 5 factors measured students' attitudes towards: (1) being quality improvement focused, (2) internalising errors regardless of harm, (3) value of contextual learning, (4) acceptability of questioning more senior healthcare professionals' behaviour and (5) attitude towards open disclosure.

Conclusion: This study has established the reliability and validity of a modified survey tool to evaluate patient safety attitudes of pharmacy students, with the potential for use in course development and evaluation.

Keywords (MeSH): Patient safety; education; pharmacy ; attitude; questionnaire

Word Count: 3808 (main text); 264 (abstract)

Tables: 4 (including appendix)

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Introduction

Patient safety has become a key priority for health systems around the world since the publication of the seminal reports *To Err is Human[1]* and *An Organisation with a Memory[2]* fifteen years ago. In 2002, World Health Organization (WHO) member states recognised the need to reduce the harm and suffering that patients and their families experience from healthcare errors, and agreed upon a resolution to improve patient safety. Education has since been considered a crucial element in minimising patient harm.[3] In 2011, the WHO published a multi-professional *Patient Safety Curriculum Guide* to assist healthcare schools to implement patient safety education.[4] However, the implementation of patient safety specific education can be challenging in already full university teaching curricula.[5]

Most pharmacy degree programs currently include education on some elements from the WHO curriculum, including aspects related to medication safety, communication and patient centred care.[6] Many students now gain work experience in healthcare settings at an earlier stage of their degrees, either through experiential placements or through casual employment, and therefore, there is a greater emphasis on the need to integrate patient safety education earlier on in professional degree programs.[7,8] In response to this, many pharmacy schools now incorporate patient safety education earlier in the curriculum.[9,10] Although evaluating patient safety knowledge is a key consideration when undertaking curriculum evaluation, it is also crucial that patient safety attitudes are understood and evaluated. This is particularly important in light of evidence that attitudes can considerably influence behaviours.[11]

There are a number of survey tools that have been used to the measure patient safety attitudes and values of health care students, each to varying degrees.[9,10,12-19] The most widely adapted and validated tool is the Patient Safety/Medical Fallibility Survey, originally developed by Madigosky et al. for use in medical students.[12] Previous studies among pharmacy students have focused on evaluating patient safety knowledge and practice beliefs using unvalidated survey tools,[9,10] and attitudes to patient safety have been largely unstudied. Therefore, the aim of this study was to validate an adaptation of Madigosky et al.'s survey tool[12] in order to evaluate patient safety attitudes and values of junior pharmacy students, and specifically understand the psychometric properties that underpin the survey.

Methods

A cross-sectional survey was conducted among first (n=281) and second (n=269) year undergraduate pharmacy students enrolled in the four-year Bachelor of Pharmacy program at the University of Sydney. As both year groups would have completed an introductory pharmacy practice unit of study and introductory clinical placements (four hours) at the time of survey completion, it was hypothesised that these two groups of students would have the most comparable clinical experience and be suitable participants in the validation of the survey instrument. Data were collected between 27-31 May 2013, with approval to conduct this study granted by the Human Research Ethics Committee at the University of Sydney (project number 2013/219).

Survey

Survey Modification

The survey tool was adapted from the *Patient Safety/Medical Fallibility Curriculum Survey* developed by Madigosky et al.[12] Specifically, the original survey items that were included, suited first year Bachelor of Pharmacy students' level of knowledge and understanding of health care systems, which resulted in the exclusion of skill and knowledge-based items from the original survey. The survey consisted of two sections. The first section consisted of 23 attitudinal items, and included 17 of the original 18 attitudinal items and utilised the original five-point Likert-type scale to measure student attitudes, with possible responses ranging from strongly disagree to strongly agree. As the survey was being modified for pharmacy students, the use of the term "physician" was changed to "pharmacist" or "medical practitioner" based on the item. Items that related to the reporting of errors were split into two questions to evaluate whether students' responses would change due to the presence or absence of patient harm. In addition, two questions to evaluate attitudes towards questioning more senior health care professionals, one question on patients' role in healthcare and one question on peer learning were added. The second section collected demographic details including gender, age, stage of education, prior healthcare experience and involvement with an incident that resulted in harm or potential harm as a result of receiving healthcare.

Face validation

The face validity of the survey instrument was assessed through focus groups among three populations: initially among 5 pharmacy academics, 5 practising pharmacists and 7 pharmacy student representatives. Based on feedback from the three groups, one of the original questions relating to uncertainty in healthcare was considered ambiguous and was removed from the final survey tool. Pharmacy academics also perceived that due to junior pharmacy students' limited

clinical experience, definitions of “Patient Safety”, “Error” and “Incident” should be included in the pretext to the survey. The student group were provided with terms defined by a range of healthcare organisations. As a result, the definitions used by the *Australian Commission for Safety and Quality in Healthcare* were selected due to both the perceived ease of understanding and perceived contextual relevance to junior pharmacy students. The final survey was approved by each group in a subsequent focus group.

Analysis

All data analyses were completed using IBM SPSS Statistics version 21 (SPSS Inc., Chicago, IL) and AMOS version 21 (Amos Development Corporation, Crawfordville, FL). Surveys with missing data were excluded from the analysis. The survey response rate was calculated by dividing the total number of surveys completed by the number of students enrolled in each year group. Participant characteristics were compared across year groups using Chi-square tests for categorical variables and Mann-Whitney and Kruskal-Wallis tests for continuous variables. In addition, the potential relationship between each of the participant demographic characteristics and their effects on survey responses were evaluated. A Bonferroni correction was applied to account for multiple comparisons, reducing the p-value for significance to 0.002.

An exploratory factor analysis (EFA) was performed on survey responses from the first year students to understand the latent structure underpinning student responses to the survey using maximum likelihood estimation and varimax rotation. As adequate sample sizes across both year groups were obtained, Kaisers criterion for factor retention was adopted with individual factors loading greater than 0.25 considered significant for retention.[20] The factor structure was assessed for a theoretical basis, with an examination of the Scree plot used to verify the number of factors retained.

The construct validity of the survey was evaluated using a confirmatory factor analysis (CFA) on the survey responses from the second year students. Each item was considered to have a latent construct and a measurement error, with both causal effects depicted by uni-directional arrows. Correlations between variables within the model were depicted using bi-directional arrows.[21] Maximum likelihood estimation was performed to calculate item loading. Items were removed from the model where there were: poor factor loading scores (being less than 0.25), insufficient number of items loading on the construct, or an insufficient theoretical basis to the construct after item removal.[20]

Boomsma's method of estimating a minimum sample size to conduct a CFA was performed based on the number of items to number of factors ratio of the model; it was estimated that 200 student responses would be adequate.[22] To evaluate the goodness of fit of the model, a number of fit statistics were examined. Firstly, the Chi Square statistic was used to evaluate model parsimony (i.e. that the model accomplishes a desired level of explanation with as few variables and relationships between variables as possible). In addition, root mean-square error of approximation (RMSEA) was used to evaluate absolute fit (a measure of how well the data sits the proposed model) and the Comparative Fit Index (CFI) was used to evaluate the comparative fit (a measure of how well the data fits a model where relationships exist between the survey items compared to a model where no relationships exist).[23,24]

Results

Participant Characteristics

A total of 245 first-year and 201 second-year pharmacy students completed the survey, resulting in survey response rates of 87.5% and 74.7%, respectively. The characteristics of the first and second year students are compared in Table 1. There were very few differences in the characteristics between the two groups of students, with the only significant difference being the number of students engaged in current employment in a pharmacy (15.6% vs 44.4%, p<0.001) and mean months worked (2.4 vs 6.9, p<0.001). However, as most students that are engaged in employment in pharmacy are undertaking non-clinical roles (19.7% vs 8.6%), it is unlikely that current employment will influence junior students' responses to the survey questions.

Table 1 – Participant characteristics

Characteristic	First year students (n=245)	Second year students (n=201)	P-value
Gender: Males, *n* (%)* Females, *n* (%)*	 90 (36.9) 154 (63.1)	 65 (32.8) 132 (66.7)	 0.37
Age, in years, mean (SD)	19.4 (3.1)	20.0 (2.0)	<0.001
Students currently working in a pharmacy, *n* (%)*	38 (15.6)	88 (44.4)	<0.001
Months worked in pharmacy (mean, SD)	2.4 (9.5)	6.7 (11.9)	<0.001
Students who have been involved in or witnessed harm while working, *n* (%)*	21 (9.7)	29 (11.9)	0.06
Students who have witnessed harm to a loved one, *n* (%)*	35 (15.9)	35 (19.1)	0.14

*Note – percentages based on denominator of number of valid responses only

Comparisons of year group and other demographic characteristics with each of the survey items showed that demographic characteristics did not influence student responses after accounting for multiple comparisons with the Bonferroni correction (Appendix 1). However, two of the 23 attitudinal items which related to the inevitability of errors in healthcare and involving the patient in healthcare, showed statistical significance between year groups (p=0.001). Prior to the EFA, these

items were removed as their exclusion was deemed not to have a significant impact on the model due to the inclusion of other survey items which measured similar concepts.

Exploratory Factor Analysis

Following the removal of 7 items, either due to low communalities (less than 0.2) or low factor loadings (less than 0.25) and examination of the Scree plot, a five factor solution was determined(Table 2). This solution explained 55.71% of the variance. Only one item cross-loaded and was assigned to a single factor based on theoretical reasoning. The five factors were labelled as being (1) quality improvement focused; (2) value of contextual learning; (3) internalising errors regardless of harm; (4) acceptability of questioning more senior healthcare professionals' behaviour and (5) attitude towards open disclosure of errors.

Table 2. Exploratory Factor Analysis (EFA) rotated factor structure

Question Number	Item	EFA Constructs					Cronbachs alpha if item deleted
		1 α=0.422	2 α=0.673	3 α=0.591	4 α=0.533	5 α=598	
Q7	Learning how to improve patient safety is an appropriate use of time in pharmacy programs at university.	0.62					0.22
Q3	Pharmacists should routinely spend part of their professional time working to improve patient care.	0.48					0.32
Q23	Peer-led education, such as from pharmacist colleagues or fellow students can help my understanding of patient safety concepts.	0.47					0.28
Q19	The care that we provide on a day to day basis could be improved.	0.47					0.37
Q5	Patients have a role to play in their own safety.	0.38					0.34
Q18	After an error occurs, an effective strategy is to work hard to be more careful.	-0.26					0.63
Q22	Patient safety education requires university lecturers to teach patient safety concepts.		-0.78				0.40
Q8	Healthcare professionals, including pharmacy staff, routinely share information about errors and what caused them.		0.76				0.54
Q6	The culture of the pharmacy workplace makes it easy for pharmacy staff to deal constructively with errors.		0.40				0.74
Q16	If I saw an error that DID NOT cause harm, I would keep it to myself			0.86			0.37
Q15	If I saw an error that DID cause harm, I would keep it to myself.			0.48			0.49

Q14	If there is no harm to a patient, there is no need to address an error.			0.42			0.58
Q10	Pharmacists should report errors to an affected patient and their family if harm to the patient has occurred.				0.97		-
Q11	Pharmacists should discuss and report errors to an affected patient and their family even if the patient is NOT harmed.				0.38		-
Q21	It is acceptable for a registered pharmacist to question the decisions of a prescriber (such as a doctor or nurse practitioner).					0.97	-
Q20	It is acceptable for an intern pharmacist to question the actions of a registered pharmacist.	0.34				0.36	-

Confirmatory Factor Analysis

In the second phase of the analysis, the construct validity of the instrument was established using CFA. After mapping the responses from the second year students to the suggested model determined by the EFA of first year students' responses, two items (Q5 and Q18) were removed due to low factor loading (less than 0.25), resulting in the final factor structure (Table 3). The Chi-squared values for overall model fit was significant, χ^2 (69) = 134.23, p <0.001, which suggested a significant misfit between the data and the model. However, it is known that in larger samples, the chi-squared value can be over-sensitive and other fit indices were assessed (RMSEA = 0.07 CFI=0.88), which suggested potential fit.[25] Modification indices suggested that freeing the covariance between two error terms in factor 1, and one error term in factor 3, as well as between one error term in factor 2 and one error term in factor 3, would improve model fit. A model including these specified correlations resulted in a subsequent model having better fit to the constrained model, χ^2 (66) = 112.83, p <0.001, RMSEA =0.06, CFI = 0.91. Utilising data from both first year students and second year students as part of a multi-group analysis, unconstrained nested model comparisons showed no significant difference in the unconstrained model between year groups ($\Delta\chi^2(7) = 3.079, p=0.878$). This indicates that both year groups satisfactorily fit the model. The combined data-set of first and second year student responses (N=446) was used to calculate the final factor loadings as seen in Figure 1.

[Insert Figure 1 here]

Table 3 – Final CFA Factor Structure

Explanation of factor structure:		Standardised regression weights	Unstandardized regression weights (URW)	Standard error of URW	Squared multiple correlations
Item number	**Item description**				
Factor 1: Being *quality improvement focused* (α=0.654)					
Q19	The care that we provide on a day to day basis could be improved.	0.40	1.00	0.39	0.16
Q3	Pharmacists should routinely spend part of their professional time working to improve patient care.	0.60	1.49	0.28	0.36
Q7	Learning how to improve patient safety is an appropriate use of time in pharmacy programs at university.	0.60	1.53	0.30	0.36
Q23	Peer-led education, such as from pharmacist colleagues or fellow students can help my understanding of patient safety concepts.	0.57	1.44	0.31	0.33
Factor 2: *Internalising errors* regardless of harm (α=0.705)					
Q16	If I saw an error that DID NOT cause harm, I would keep it to myself.	0.72	1.00	0.45	0.52
Q15	If I saw an error that DID cause harm, I would keep it to myself.	0.65	0.63	0.27	0.42
Q14	If there is no harm to a patient, there is no need to address an error.	0.53	0.63	0.49	0.28
Factor 3: Value of *contextual learning* (α=0.570)					
Q22	Patient safety education requires university lecturers to teach patient safety concepts.	0.95	1.00	0.06	0.90

Q8	Healthcare professionals, including pharmacy staff, routinely share information about errors and what caused them.	-0.59	-0.68	0.48	0.34
Q6	The culture of the pharmacy workplace makes it easy for pharmacy staff to deal constructively with errors.	-0.34	-0.35	0.51	0.12
Factor 4: Acceptability of *questioning* more senior healthcare professionals' *behaviour* (α=0.718)					
Q20	It is acceptable for an intern pharmacist to question the actions of a registered pharmacist.	0.64	1.00	0.31	0.40
Q21	It is acceptable for a registered pharmacist to question the decisions of a prescriber (such as a doctor or nurse practitioner).	0.77	1.00	0.14	0.60
Factor 5: Attitude towards *open disclosure* of errors (α=0.534)					
Q10	Pharmacists should report errors to an affected patient and their family if harm to the patient has occurred.	0.74	1.00	0.22	0.55
Q11	Pharmacists should discuss and report errors to an affected patient and their family even if the patient is NOT harmed.	0.53	1.00	0.71	0.28

Discussion

This study has validated a modified version of an existing patient safety attitudinal survey tool, the *Patient Safety/Medical Fallibility Curriculum survey,[12]* in pharmacy students. A robust two-staged analytical method, involving EFA followed by CFA, was used to assess the reliability and validity of the survey tool. The results of these analyses demonstrated that the attitudes which underpin students' responses could be explained by five underlying dimensions: (1) being quality improvement focused, (2) internalising errors regardless of harm, (3) value of contextual learning, (4) acceptability of questioning more senior healthcare professionals' behaviour and (5) attitude towards open disclosure of errors. Four of these dimensions related to patient safety attitudes (Factors 1, 2, 4 & 5) and one pertained to the delivery of patient safety interventions (Factor 3). This survey tool can therefore be used to help assess the educational needs of students and evaluate patient safety educational interventions.[26]

The first factor pertained to willingness to undertake quality improvement activities. The EFA on first year students' responses revealed a relatively low internal consistency reliability for this factor (Cronbach alpha =0.422). Two items (Q5 – Patients have a role to play in their own safety and Q18 – After an error occurs, an effective strategy is to work hard to be more careful) had a relatively low loading on the factor and made little contribution to the meaning of the factor. After the removal of these items during the CFA process, there was a significant improvement in the Cronbach alpha in second year responses (0.654), thereby demonstrating improved internal consistency. This factor examined a positive attitude towards patient safety. Specifically this factor, focused on quality improvement as an indicator of positive safety culture, with higher scores indicating a greater emphasis towards taking a systems approach to dealing with errors, a desired outcome of many patient safety programs.[27] The second factor, however, measured a negative attitude toward patient safety. This factor related to managing and reporting risk, whereby students internalise the error rather than take action, regardless of whether the patient suffered harm. Thus higher scores indicate that students may be less likely to appropriately manage an error. Scores on these factors are important given that there is a push towards teaching incident reporting from junior years to foster good behaviours and to develop a culture of understanding and preventing errors.[28] Consequently, as students become more quality improvement focused (as measured by factor 1), it would be expected that they would be more likely to appropriately manage an error rather than internalising the issue (resulting in a corresponding decrease in scores on factor 2).[29]

The fourth factor measured how acceptable it is to students to question the decisions of more senior healthcare professionals, an important part of managing risk in healthcare. Whilst the two items in this scale are clearly related, these two items do differ significantly. The first item in the factor relates to questioning the decision of a prescriber, whilst the second item relates to the questioning of an action of a more senior pharmacist. Previous studies have identified that a major obstacle to good patient safety practices among students is the hierarchical structure of healthcare organisations, including community pharmacies where most pharmacy students obtain their first clinical experience.[30,31] Being able to work well within teams has been associated with reduced medical errors and improved outcomes in primary healthcare.[32-34] In addition to effective communication, being able to deal with conflict, particularly with more senior healthcare practitioners, is also considered an important skill.[35] Many patient safety education programs now include training in managing situations resulting in conflict, and whilst this factor may not be able to directly examine this skill, by measuring students' attitudes, it indirectly evaluates whether there is a need for further training in this area.

A core element of all patient safety programs is the concept of patient-centred care, which includes involving the patient in decisions about their own care and openly disclosing incidents when they occur. Factor five related to open disclosure of errors and hence may be used as a measure of students' willingness to openly disclose errors to patients, regardless of whether or not harm occurs. Despite being uncommon in practice, open disclosure of errors by health care practitioners is desired by patients and required by healthcare authorities.[36] Furthermore, it has been shown that it is important for educators to commence open disclosure training as early as possible in order to have the greatest impact on changing this behaviour.[37]

The final factor (Factor 3) related to the educational delivery of patient safety interventions. It focused on the pedagogical method that would be most effective in delivering patient safety education to junior pharmacy students[26] with items relating to the didactic method of teaching patient safety through university lectures, and learning from experience in the workplace. It is known that the learning preferences of students change throughout their degree, with more meaning-directed approaches preferred as they progress through their degree.[38] This factor may therefore be useful to guide the development of teaching materials, tailored to better suit students' learning style preferences.

Despite the survey being used previously in evaluating patient safety attitudes of both medical and nursing students, only one study has investigated the psychometric properties of the original survey.[15] Schnall et al.[15] utilised 17 of the skill and attitudinal items from the original survey to identify a nine item, three factor solution: "Error detection, time investment and creating a culture of safety". Five of the nine items included in Schnall's factor analysis were also included in our final CFA model, however, were placed under different factors in our analysis. Like Schnall et al., the present study observed low reliability scores in our factors during the EFA with first year students. However, when applying the EFA factor structure to our second year students, reliability scores increased, which indicates that students may understand and relate to survey items better the further they have progressed in their degrees as a result of receiving more practice-specific education.

Implications for Educators

The use of this survey tool provides a number of benefits for educators. Given that the literature identifies a significant need to provide more training to pharmacy and other healthcare students on all aspects of patient safety, it is crucial that pharmacy schools have a mechanism for evaluating the impact of these programs.[26,39-41] It is noteworthy that current patient safety programs for pharmacy students often include elements of identifying, understanding, reporting, managing and communicating risk. The underlying attitudes leading to the practice of these positive safety behaviours can all be evaluated using the survey tool. In addition, there are a number of potential benefits which may arise through the repeated use of this tool throughout a student's degree program. Firstly, it will provide a means to evaluate the longitudinal effect of patient safety education interventions and changes in students' attitudes. It can also be used to measure the effect of the informal and hidden curricula on students' patient safety attitudes, which is particularly important as students commence experiential learning placements and as more students engage in casual employment in assistance roles. Thus the evaluation of these changes can provide useful information about the educational needs of students through their degrees and when additional and more targeted interventions will need to be provided.

Strengths and Limitations

This study has a number of strengths. Firstly, in the absence of a published survey tool to evaluate the patient safety attitudes of pharmacy students, this study modified one of the most highly utilised survey tools to measure the patient safety attitudes of healthcare students[12,13,15] in order to suit the requirements of junior pharmacy students. Furthermore, the relatively large sample size

obtained (N=446) allowed for a rigorous analytical approach to be undertaken, enabling both EFA and CFA to be performed with sufficient sample sizes for validation of the survey tool. In addition, the high response rates of students completing the survey (87.5% of first year students and 74.7% of second year students) means that the findings are likely to be representative of the attitudes of junior pharmacy students undertaking the Bachelor of Pharmacy program at the University of Sydney. However, as the sample was drawn exclusively from a single institution, the findings may not be representative of students enrolled in other pharmacy programs. In addition, despite test-retest reliability not being performed, conducting a CFA on data collected at the same time ensured a form of reliability in the study. Finally, two of the factors (factor 4-questioning behaviours and factor 5-open disclosure) consisted of only two items. While this is considered acceptable,[42] it is also a potential limitation that is likely a consequence of the relatively short survey tool utilised. However, the two items that loaded on these two factors adequately described the latent concepts being measured, and are appropriate to the level of understanding and knowledge that junior pharmacy students have of the health care system.

Conclusion

This study has demonstrated the validity of a tool to evaluate the attitudes of pharmacy students across a number of patient safety areas. Given that there is growing recognition of the need to educate pharmacy students in patient safety concepts, this survey can be used by pharmacy schools to evaluate the underlying dimensions of students' patient safety attitudes, which have direct effects on the manner in which students practice. Through the use of this tool, pharmacy schools will be able to further develop and tailor their patient safety training to better suit students' educational needs.

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Competing Interests

None

Contributorship Statement

RW conceived and designed the study, delivered peer educator training, collected and analysed the data and drafted the manuscript. RF assisted in the design of the study, analysis of the results and revised the manuscript. SC assisted in the analysis of the results and revised the manuscript. AM and TC assisted in the design of the study and revised the manuscript.

Data Sharing Statement

No additional data are available

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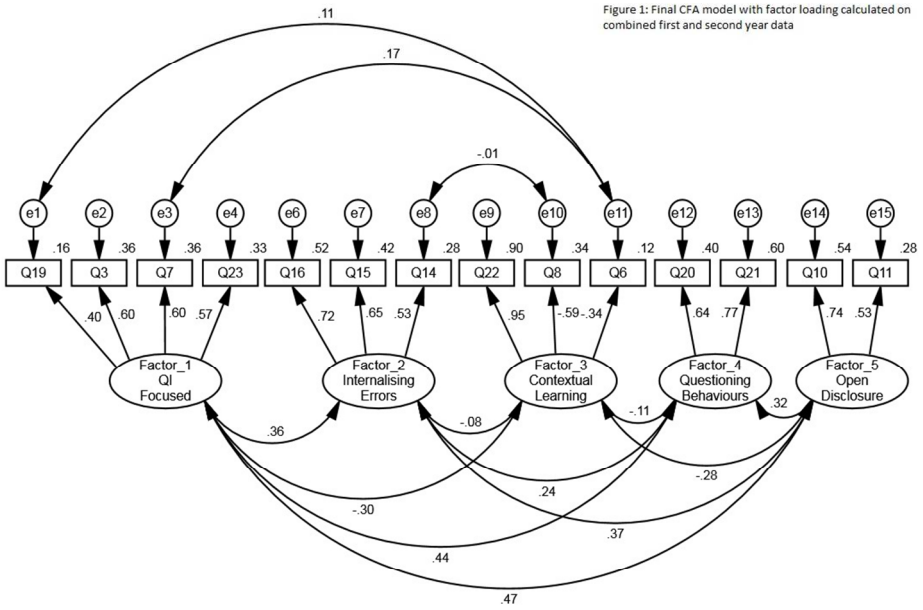

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Validation of a survey tool to assess the patient safety attitudes of pharmacy students

Appendix 1 – Factors that may affect students' responses

Question Number	Item	Effect of demographic detail on survey response (P – Value)*						
		Year Group	Gender	Age	Prior health experience	Current Pharmacy Employment	Witnessed harm at work	Witnessed harm to a loved one
Q1	Errors in healthcare are inevitable.	**0.001**	0.455	0.827	0.189	0.284	0.208	0.148
Q2	Competent health care professionals do not make errors that lead to patient harm.	0.765	0.232	0.861	0.167	0.686	0.113	0.601
Q3	Pharmacists should routinely spend part of their professional time working to improve patient care.	0.830	0.891	0.493	0.548	0.506	0.336	0.931
Q4	Only medical practitioners can determine the causes of a medical error.	0.215	0.437	0.253	0.090	0.188	0.091	0.087
Q5	Patients have a role to play in their own safety.	**0.001**	0.896	0.318	0.747	0.140	0.132	0.916
Q6	The culture of the pharmacy workplace makes it easy for pharmacy staff to deal constructively with errors.	0.578	0.450	0.584	0.302	0.398	0.220	0.855
Q7	Learning how to improve patient safety is an appropriate use of time in pharmacy programs at university.	0.664	0.221	0.051	0.926	0.378	0.168	0.169
Q8	Healthcare professionals, including pharmacy staff, routinely	0.794	0.662	0.097	0.428	0.723	0.208	0.747

	share information about errors and what caused them.							
Q9	In my experience, faculty and staff communicate to me that patient safety is a high priority.	0.807	0.900	0.478	0.249	0.782	0.273	0.290
Q10	Pharmacists should report errors to an affected patient and their family if harm to the patient has occurred.	0.135	0.280	0.394	0.098	0.624	0.073	0.083
Q11	Pharmacists should discuss and report errors to an affected patient and their family even if the patient is NOT harmed.	0.048	0.340	0.330	0.223	0.598	0.674	0.685
Q12	Effective responses to errors in the delivery of healthcare focus primarily on the healthcare professional involved	0.014	0.897	0.122	0.335	0.751	0.060	0.095
Q13	Disciplinary action against an individual who made an error is an effective method of preventing future errors.	0.762	0.612	0.777	0.921	0.423	0.023	0.855
Q14	If there is no harm to a patient, there is no need to address an error.	0.917	0.961	0.057	0.210	0.537	0.084	0.264
Q15	If I saw an error that DID cause harm, I would keep it to myself.	0.799	0.341	0.283	0.659	0.127	0.056	0.253
Q16	If I saw an error that DID NOT cause harm, I would keep it to myself.	0.416	0.678	0.232	0.038	0.237	0.055	0.989
Q17	Most errors are due to things that healthcare professionals can't do anything about.	0.423	0.499	0.260	0.925	0.472	0.727	0.128
Q18	After an error occurs, an effective strategy is to work hard to be	0.091	0.087	0.154	0.297	0.410	0.035	0.125

	more careful.							
Q19	The care that we provide on a day to day basis could be improved.	0.249	0.562	0.116	0.331	0.038	0.425	0.109
Q20	It is acceptable for an intern pharmacist to question the actions of a registered pharmacist.	0.183	0.0.34	0.471	0.207	0.983	0.849	0.473
Q21	It is acceptable for a registered pharmacist to question the decisions of a prescriber (such as a doctor or nurse practitioner).	0.864	0.276	0.856	0.491	0.477	0.152	0.703
Q22	Patient safety education requires university lecturers to teach patient safety concepts.	0.879	0.528	0.358	0.245	0.604	0.421	0.056
Q23	Peer-led education, such as from pharmacist colleagues or fellow students can help my understanding of patient safety concepts.	0.603	0.441	0.450	0.563	0.269	0.198	0.247

*Bonferroni Adjusted P-Value : 0.002