Safety Culture in Pharmacy Setting Using Pharmacy Survey on Patient Safety Culture: A Cross-sectional Study in China

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Abstract

Objective To explore the attitudes and perceptions of patient safety culture for pharmacy workers in China by using a Pharmacy Survey on Patient Safety Culture (PSOPSC), and to assess the psychometric properties of the translated Chinese-language version of the PSOPSC.

Design Cross-sectional study.

Participants Data were obtained from 20 hospital pharmacies in southwest part of China.

Method Chi-Square test was performed to explore the differences on pharmacy staff in different hospital and qualification levels and countries towards patient safety culture. We also computed descriptive statistics, internal consistency coefficients and inter-subscale correlation analysis, then conducted a exploratory factor analysis. A test–retest was performed to assess reproducibility of the items.

Result A total of 630 questionnaires were distributed of which 527 were responded validly (response rate 84 %). The positive response rate for each item ranged from 37% to 90%. The positive response rate on three dimensions ("*Teamwork", "Staff Training and Skills"* and "*Staffing, Work Pressure, and Pace"*) was higher than that of Agency for Healthcare Research and Quality(AHRQ) data ($P<0.05$). There was a statistical difference on the perception of patient safety culture in different hospital and qualification levels. The internal consistency of the total survey was comparatively satisfied (Cronbach's $\alpha=0.89$).

Conclusion The results demonstrated that among the pharmacy staffs surveyed in China,there was a positive attitudes towards patient safety culture in their organizations. Identifying perspectives of patient safety culture from pharmacists in different hospital and qualification levels are important,since this can help support decisions about action to improve safety culture at pharmacy settings. The Chinese translation of PSOPSC questionnaire (version 2012) applied in our study is

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acceptable.

Strengths and limitations of this study

- This is the first kind of study that was conducted in China measuring patient safety culture in pharmacy setting. The results of this study may provide some evidence to help healthcare decision makers or policy makers in pharmacy settings from developing countries to develop effective strategies to assess areas of strength and identify areas for improvement in their patient safety culture as part of their quality improvement activities.
- Findings might be limited by selection bias as pharmacies were selected on a convenient basis. Our study was carried out only in the Second-grade and Third-grade hospitals which may not reflect the whole picture of patient safety culture in China. Meanwhile, this is the first kind of study using PSOPSC to measure safety culture in pharmacy setting, there are no similar studies from benchmark scores using PSOPSC for us to compare with, so the external comparison was restrictive.

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Background

Medication errors are the largest component of medical errors accounting for about a quarter of the incidents which threaten patient safety.[1] An estimated 770000 people are injured or die in hospitals from adverse drug events(ADEs) each year which are injuries resulting from drug use. Approximately 28% of ADEs are associated with a medication error and therefore are judged to be preventable.[2] Fifty percent of these ADEs could have been prevented by a pharmacist.[3] It appears that pharmacists and clinical pharmacy services can substantially improve patient safety and reduce hospital costs associated with medication errors.[1] Meanwhile, the report by Institute of Medicine (IOM) indicated for a safety culture in which adverse events can be reported without people being blamed, and that when mistakes occur that lessons are learned.[4] Therefore, if hospital pharmacies want to improve patient safety, it is important to know more about the views of their staff in relation to the culture of patient safety.

Today, reducing medication errors and improving patient safety have become common topics of health services around the world.[5] Many developed countries have initiated the research into the role played by patient safety culture research. On a global basis, several international organizations promote the establishment of a culture of patient safety: the WHO Patient Safety Programme will launch in 2014 the Third Global Patient Safety Challenge, focusing on medication safety, the National Patient Safety Agency in the UK, the Agency for Healthcare Research and Quality in US, The Australia Commission of Safety and Quality, and The European Foundation for the Advancement of Healthcare Practitioners.[4,6] There are some developing countries that are oblivious to the problems created by medication errors. However, efforts are now being taken in these countries, especially India, China and Philippines, to set up pharmacovigilance system for collection of information on ADEs.[6-8]

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As pharmacies continually strive to improve safety and quality, there is a growing recognition of the importance of establishing a culture of patient safety. Achieving such a culture requires an understanding of the values, and beliefs about what is important in the organization and what attitudes and behaviors related to patient safety are expected.[9] The assessment of safety culture in pharmacies has recently begun to develop and the consistency of methods and instruments used across pharmacies needs to be further elaborated.[10] Quite often, hospital pharmacies have been included in overall hospital based safety culture assessments.[11-16] There are a few studies of pharmacy survey on patient safety culture by using different scales.[10,17-19] However, most of these studies focused on the evaluation of the psychometric properties of the scales or on developing, and examining the component structure and internal consistency of the survey instruments.[10,18,19] E.g. the study by Ashcroft aims to develop a Pharmacy Safety Climate Questionnaire (PSCQ) and examine the component structure and internal consistency in the community pharmacy setting in England.[19] Nevertheless, no study to date, to our knowledge, using survey developed for pharmacists has been published in which the safety culture in hospital pharmacies has been assessed.

In this study, we measured the patient safety culture in China's hospital pharmacies by using the modified version of Pharmacy Survey on Patient Safety Culture (PSOPSC) developed by AHRQ (version 2012).[9] We also compared some of the findings with existing data from the AHRQ pilot study. Meanwhile, we intended to assess the quality of this investigative questionnaire.

Methods

Questionnaire

The Pharmacy Survey on Patient Safety Culture (PSOPSC) was translated and modified to suit the Chinese system. The original PSOPSC was developed by AHRQ in 2012 on the purpose of pilot study which was designed to assess 11 dimensions of pharmacy with 36 items of patient safety

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culture.[9] The questionnaire also included three questions that ask respondents to rate the frequency with which mistakes were documented and one question that provides an overall rating on patient safety.[20] Additionally, the original PSOPSC contained a section of *"Background Questions"* as well as an open ended section. We made a slight emendation of PSOPSC questionnaire by combining two items—(A3:"*Technicians in this pharmacy receive the training they need to do their jobs"* and A10: " *Staff get enough training from this pharmacy"*) into one item because they were almost the same meaning in Chinese translation. Furthermore, we added two items to the section *"Background Questions"*—(gender and hospital levels) and refreshed the qualification categories to adapt to Chinese context.

The survey used either 5-point agreement scales ("Strongly disagree" to "Strongly agree") or frequency scales ("Never" to "Always"). Items include a "Does not apply or Don't know" option.[20]

The permission to use PSOPSC was obtained from AHRQ. The Chinese translation was carried out in several steps. First, the recommended guideline of PSOPSC: *User's Guide* was carefully discussed within the research group before translation. The first translation was done by a graduate medical student with background in patient safety. Then, the translation was double checked and reviewed by the research group including experts in pharmacy, methodologists, and English. We had a further discussion regarding to some wordings and especially on some items that would cause misunderstanding in Chinese language.

Sample

Convenient sampling was used to survey hospital pharmacies throughout southwest part of China. The self-administered questionnaire was conducted over six months from March through August 2013 with 20 hospital pharmacies included. We involved in all pharmacy staff working in the pharmacy area where prescriptions were dropped off, filled, dispensed, and picked up or prepared for delivery.[9]

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To ensure the privacy of the respondents, the survey was strictly anonymous. Permission to conduct the investigation was granted by the hospital pharmacy directors before investigation. The participants were informed of the purpose of the survey and voluntarily completed a paper copy of the questionnaire by the research coordinators in different hospitals.

Data screening and collection

After receiving the completed questionnaires, a preprocessing step was applied to remove incomplete or invalid data and based on the study by Hellings J.[14] We checked and examined the returned questionnaire. The exclusion criteria were similar to two studies: 1) there was no entire section completed; 2) there was fewer than half items answered or all the items answered the same.[4,14] All data was entered by two researchers (Jia PL and Zhang LH) independently, and then were cross-checked mutually by Epidata (version, 3.02). In case of doubts or disagreement in some answers, we looked into the original questionnaires. Negatively worded items were reversed to ensure that positive answers indicated a higher score. Most of the items in the questionnaire used the Likert 5- point response scale of agreement (Strongly disagree to Strongly agree) or frequency (Never to Always), so the lowest three scoring(1-3) answers (Strongly disagree/Disagree/Neither Agree nor Disagree or Never/Rarely/Sometimes), the highest two scoring (4-5) answers(Agree /Strongly agree or Most of the time/Always), as well as the highest two scoring answers were perceived as positive response answers, and the lowest three scoring answers were deemed other response answer. We calculated the positive response rate according to the formula by the User's Guide of PSOPSC.[9] Items marked as "Does Not Apply/Don't Know" response option by the respondents were excluded when displaying percentages of response and the positive response scores.[9]

Data analysis

We analyzed the demographic characteristics using the Excel 2007. The number of positive response/positive response rate of all the items was also summarized. Positive response rate was used

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to evaluate the attitudes towards patient safety culture on different dimensions or items. We used Chi-Square test to compare whether there was a statistical difference on pharmacy staff in hospital and qualification levels towards patient safety culture. A Chi-squared test was also used to infer if there was a statistical difference on *"patient safety grade"* in Chinese pharmacies compared with that of US pharmacies, with the significant level of $P = 0.05$.

We calculated Cronbach's a and exploration factor analysis to evaluate the quality of the questionnaire. Internal consistency value (Gronbach's $\alpha \geq 0.70$) for newly developed scales was recommended.[4] Structure validity was explored using principal component factor analysis by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO> 0.7) and by Bartlett's Test of Sphericity $P < 0.05$.

Intercorrelations among 11 dimensions were calculated using the non-parametric Spearman test as it is adapted to qualitative ordinal variables. The correlations should be less than 0.8 for the composites to be considered unique and avoid problems with multicollinearity.[12]

A test–retest was administered in a specialized hospital to assess the reproducibility. Thirty-three randomly selected pharmacy staff were asked to answer the questionnaire twice with a 2-week interval between the test and the retest. Test–retest reliability was assessed by the one-way intra-classcorrelation coefficient (ICC type (1, 1).[21] Reliability was considered good if ICC was greater than 0.70.[21]

Ethic

This was a non-interventional survey.We were informed that no required from the ethics committee needed this time by the hospital ethics committee. However, responding to the questionnaire was voluntary and all answers were de-identified to maintain confidentiality.

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Results

Sample and response statistics

A total of 630 questionnaires were distributed of which 527 were responded validly (84%). Three hundred and seventy nine (72%) of the respondents were female, 421 (80%) were junior pharmacists, followed by pharmacy interns (16%) and senior pharmacists (4%). The majority of the respondents (68%) was from Third-grade hospitals (Table 1).

Table 1 Demographic characteristics of respondents

Characteristics	Senior pharmacist (n = 20)	Junior pharmacist (n = 421)	Pharmacy intern (n = 86)	Total (n = 527)
Sex				
Male	4(2.7)	115(77.7)	29(19.6)	148(100[a])
Female	16(4.2)	306(80.8)	57(15.0)	379(100)
Working time in hospital				
Less than 6 months	3(5.6)	40(74.1)	11(20.4)	54(100)
6 months to less than 1 year	5(6.4)	57(73.1)	16(20.5)	78(100)
1 to 3 years	5(4.0)	104(83.9)	15(12.1)	124(100)
3 to 6 years	3(3.0)	82(81.2)	16(15.8)	101(100)
6 to 12 years	1(1.4)	55(77.5)	15(21.5)	71(100)
12 years or more	3(3.0)	83(83.8)	13(13.1)	99(100)
Working hours per week				
1 to 16 hours	0(0)	14(87.5)	2(12.5)	16(100)
17 to 31 hours	1(4.5)	18(81.8)	3(13.6)	22(100)
32 to 40 hours	14(4.7)	244(73.2)	42(14.0)	300(100)
More than 40 hours	5(2.6)	145 (76.8)	39(20.6)	189(100)
Hospital level [b]				
Third-grade hospital	14(3.9)	290(81.2)	53(14.8)	357(100)
Second-grade hospital	6(3.5)	131(77.1)	33(19.4)	170(100)

[a] Parenthesis represent percentage

[b] Third-grade hospital: provincial and municipal hospital
Second-grade hospital: reginal hospital

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In our study, the percentage of positive responses for the 11 patient safety culture dimensions ranged from 50% to 88%, the mean positive response rate was 71%. The lowest positive response rate of dimension was *"Staffing, Work Pressure, and Pace"* (50%), while the highest positive response rate of dimension was "*Staff Training and Skills"* (88%). There were two dimensions of which positive response rate were less than 60% such as "*Patient Counseling"*(57%), and "*Staffing,Work Pressure, and Pace"* (50%). The positive response rate for the rest of the items ranged from 37% to 90%. The highest positive response rate of the three items reached 90% , while the lowest positive response rate of the item was "*Staff feel like their mistakes are held against them"*(37%)(Table 2).

However, the 2012 Preliminary Comparative Results: PSOPSC in US showed that the average positive response rate of 11 dimensions ranged from 41% to 90%, the overall average positive response rate for dimensions was 78%. The lowest positive response rate of item was "*We feel rushed when processing prescriptions"*(14%) and the highest positive response rate item was"*Our pharmacists tell patients important information about their new prescriptions"* (93%).There were 4 items of which the positive response rate were less than 60% (Table 2).

There were some differences between the adapted Chinese PSOPSC with that of original US PSOPSC, so only the same items were compared to explore the differences of perceptions towards patient safety culture between the two countries. The results showed that there was a significant difference on three items ($P < 0.05$) of which the positive response rate on three items in China was higher than that of the US. These dimensions were (1) *Teamwork, (2) Staffing, Work Pressure, and Pace.* However, there was a significant difference on 18 items ($P < 0.05$), which of the positive response rate on 18 items in China was lower than that of the US (Table 2).

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Table2 Positive response rate of each item , Cronbach's α for dimensions and reproducibility

Dimension/items(internal consistency reliability coefficient)	US	China	ICC
1 Physical Space and Environment (Cronbach's α=0.60)	72%	69%	
A1. This pharmacy is well organized.	84%	84%	0.86
A5. This pharmacy is free of clutter	67%	53%	0.80
A7. The physical layout of this pharmacy supports good workflow.	65%	69%	0.69
2. Teamwork (Cronbach's α=0.44)	81%	84%	
A2. Staff treat each other with respect.	79%	86%	0.74
A4. Staff in this pharmacy clearly understand their roles and responsibilities.	81%	90%	0.86
A9. Staff work together as an effective team.	82%	77%	0.80
3. Staff Training and Skills(Cronbach's α=0.75)	79%	88%	
A3. Technicians in this pharmacy receive the training they need to do their jobs	81%	87%	0.78
A6. Staff in this pharmacy have the skills they need to do their jobs well.	86%	90%	0.86
A8. Staff who are new to this pharmacy receive adequate orientation	72%	88%	0.86
4. Communication Openness(Cronbach's α=0.57)	87%	64%	
B1. Staff ideas and suggestions are valued in this pharmacy	81%	64%	0.30
B5. Staff feel comfortable asking questions when they are unsure about something	91%	72%	0.88
B10. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns	88%	57%	0.52
5. Patient Counseling(Cronbach's α=0.69)	90%	57%	
B2. We encourage patients to talk to pharmacists about their medications.	92%	56%	0.80
B7. Our pharmacists spend enough time talking to patients about how to use their medications	86%	52%	0.94
B11. Our pharmacists tell patients important information about their new prescriptions	93%	63%	0.73
6. Staffing, Work Pressure, and Pace(Cronbach's α=0.50)	41%	50%	
B3. Staff take adequate breaks during their shifts	56%	60%	0.92
B9. We feel rushed when processing prescriptions. (negatively worded)	14%	40%	0.81
B12. We have enough staff to handle the workload.	56%	62%	0.92
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)	40%	37%	0.72
7. Communication About Prescriptions Across Shifts(Cronbach's α=0.84)	81%	79%	
B4. We have clear expectations about exchanging important prescription information across shifts	84%	83%	0.79
B6. We have standard procedures for communicating prescription information across shifts.	78%	77%	0.72
B14. The status of problematic prescriptions is well communicated across shifts	81%	77%	0.76
8. Communication About Mistakes(Cronbach's α=0.17)	79%	62%	
B8. Staff in this pharmacy discuss mistakes.	74%	50%	0.93
B13. When patient safety issues occur in this pharmacy, staff discuss them.	84%	57%	0.73
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.	81%	78%	0.68
9. Response to Mistakes (Cronbach's α=0.57)	79%	65%	
C1. Staff are treated fairly when they make mistakes	80%	81%	0.71
C4. This pharmacy helps staff learn from their mistakes rather than punishing them	84%	66%	0.84
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.	84%	76%	0.86
C8. Staff feel like their mistakes are held against them. (negatively worded)	69%	37%	0.66
10. Organizational Learning—Continuous Improvement(Cronbach's α=0.48)	83%	84%	
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.	90%	90%	0.74
C5. When the same mistake keeps happening, we change the way we do things	82%	81%	0.71
C10. Mistakes have led to positive changes in this pharmacy	79%	82%	0.76
11. Overall Perceptions of Patient Safety (Cronbach's α=0.45)	84%	80%	
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)	80%	79%	0.73
C6. This pharmacy is good at preventing mistakes.	85%	76%	0.94
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.	86%	84%	0.68

ICC, intra-class correlation coefficient

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Comparative results

The results showed that there was a significant difference on seven dimensions between Third-grade hospital and Second-grade hospital ($P < 0.05$). The positive response rate of five items of Third-grade hospitals was lower than that of Second-grade hospitals: (1) *This pharmacy is free of clutter* (2) *Our pharmacists spend enough time talking to patients about how to use their medications* (3) *Staff take adequate breaks during their shifts* (4)*We feel rushed when processing prescription* (5) *Interruptions/distractions in this pharmacy make it difficult for staff to work accurately"* ($P < 0.05$). The positive response rate of other items of Third-grade hospitals was higher than that of Second-grade hospitals (Table 3).

Incidence of patient safety events was closely related to the qualification levels of pharmacists. Our results showed that there was a significant difference in the positive response rate on two dimensions("*Staffing, Work Pressure, and Pace"*and "*Communication About Prescriptions Across Shifts",* $P<0.05$) for senior pharmacists, junior pharmacists and pharmacy intern. Furthermore, the positive response rate of pharmacists with high qualification(senior pharmacists) was higher than those with low qualification level (junior pharmacists) on the two items: "*Staff take adequate breaks during their shifts"*and "*We have standard procedures for communicating prescription information across shifts"* $P<0.05$ (Table 3).

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able 3 The comparison of attitudes of different levels of hospitals and qualification of hospital pharmacists on patient safety culture

Items	Hospital Levels						Qualification Levels				
	Third-grade Hospital		Second-grade Hospital		χ^2	*p*	Senior Pharmacist		Junior Pharmacist		Pharm Inte
	NPR	NOR	NPR	NOR			NPR	NOR	NPR	NOR	NPR
organized.	316	41	123	47	21.63	0.000	18	2	355	66	66
of clutter	171	186	107	63	10.45	0.001	12	8	223	198	43
this pharmacy supports good workflow.	236	121	123	47	2.07	0.15	16	4	288	133	55
with respect.	308	49	141	29	1,01	0.31	18	2	360	61	71
clearly understand their roles and responsibilities.	321	36	150	27	0.34	0.56	19	1	312	49	80
an effective team.	283	74	116	54	7,63	0.006	16	4	321	100	62
armacy receive the training they need to do their jobs	308	49	139	31	1.82	0.18	14	6	353	68	73
have the skills they need to do their jobs well.	319	38	150	27	0.15	0.70	19	1	376	45	74
his pharmacy receive adequate orientation	309	48	144	26	0.33	0.57	17	3	360	61	76
tion are valued in this pharmacy	220	137	101	69	0.24	0.63	16	4	253	168	52
asking questions when they are unsure about something	255	102	110	60	2.45	0.12	17	3	289	132	59
speak up to their supervisor/ manager about patient safety concerns in this pharmacy.	193	164	92	78	0.000	0.99	9	11	232	189	44
s to talk to pharmacists about their medications.	192	165	87	83	0.31	0.58	14	6	217	204	48
l enough time talking to patients about how to use their medications	274	83	137	33	0.99	0.32	13	7	231	208	46
patients important information about their new prescriptions	214	143	94	76	1.03	0.31	12	8	247	174	49
eaks during their shifts	187	170	121	49	16.75	0.000	18	2	245	176	45
processing prescriptions. (negatively worded)	110	247	87	83	20.40	0.000	8	12	153	268	36
f to handle the workload.	212	145	202	68	0.02	0.89	15	5	251	170	48
ons in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for ly. (negatively worded)	116	241	71	99	4.32	0.04	6	14	147	274	34
tion about exchanging important prescription information across shifts	171	186	101	69	6.11	0.01	17	3	333	88	61
ced ures for communicating prescription information across shifts.	241	116	126	44	2.28	0.12	16	4	303	118	48
nation prescriptions is well communicated across shifts	257	100	126	44	0.26	0.61	18	2	307	114	58
discuss mistakes.	180	177	72	98	3.00	0.08	11	9	201	220	40
ssues occur in this pharmacy, staff discuss them.	208	149	84	86	3.65	0.06	11	9	233	188	48
talk about ways to prevent mistakes from happening again.	283	74	116	54	7.63	0.006	16	4	319	102	64
when they make mistakes	287	70	131	39	0.78	0.38	17	3	330	91	71
staff learn from their mistakes rather than punishing them	222	135	120	50	3.57	0.06	15	5	275	146	52
s and the way we do things to understand why mistakes happen in this pharmacy.	268	89	117	53	2.28	0.13	15	5	313	108	57
stakes are held against them. (negatively worded)	118	239	68	102	2.43	0.12	5	15	152	269	29
ens, we try to figure out what problems in the work process led to the mistake.	323	34	145	25	3.11	0.08	19	1	371	50	78
e knows happening, we change the way we do things	291	66	127	43	3.25	0.07	18	2	335	86	65
positive changes in this pharmacy	298	59	118	52	13.70	0.000	16	4	337	84	63
more emphasis on sales than on patient safety. (negatively worded)	274	83	132	38	0.05	0.82	17	3	323	98	66
at preventing mistakes.	276	81	116	54	4.98	0.03	17	3	315	106	60
in this pharmacy reflects a strong focus on patient safety.	306	51	129	41	7.73	0.005	19	1	351	70	65
es the patient and could cause harm but does not,how often is it documented?	200	157	99	71	0.23	0.63	12	8	243	178	44
es the patient but has no potential to harm the patient, how often is it documented?	207	150	95	75	0.21	0.65	13	7	246	175	43
ould have harmed the patient is corrected before he medication, leaves pharmacy, ented?	209	148	95	75	0.33	0.56	14	6	244	177	41

ber of positive response answers; NOR,Number of other response

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Patient safety grade in China and the US and different qualification levels

The percentage of staff who rated the level of patient safety as "*good"*, "*very good*"or "*Excellent*" was 79% in our study, which was lower than the US score of 95%, there was a significant difference between the two groups (P<0.001). While there was no significant difference on "*Patient safety grade"* in different qualification levels (P=0.66) (Table 4).

Table 4 The comparisons of patient safety grade between different position of hospital pharmacists

Patient safety grade	Senior Pharmacist (%)	Junior Pharmacist (%)	Pharmacy Intern(%)	China(%)	US(%)
Excellent	2[a](6.5)	25(80.6)	4(12.9)	84(16)	191(40)
Very good	1(1.2)	69(85.2)	11(13.6)	227(43)	211(44)
Good	6(5.6)	80(74.8)	21(19.6)	105(20)	53(11)
Fair	7(3.1)	184(81.4)	35(15.5)	79(15)	24(5)
Poor	4(4.9)	63(76.8)	15(18.30	32(6)	0

[a] number of the respondents

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Reliablity and validity

In our research, the Cronbach's alpha was of 0.89 for the questionnaire and ranged from 0.17 to 0.83 for dimensions. The dimension"*Communication About Mistakes"* had the lowest coefficients of 0.17 (Table 2). Yet in the US, the Cronbach's α was ranged from 0.68 to 0.89 for dimensions of which "*Staffing, Work Pressure, and Pace"* had the lowest values of 0.68.

Bartlett's test of the 35 items on patient safety culture demonstrated a sufficient inter-item correlation: $\chi^2 = 12037.98$, df = 595, $P < 0.01$. Furthermore, the Kaiser –Meyer-Olkin measure of sampling adequacy was satisfactory, with a value of 0.935. Explorative factor analysis was performed using principal component analysis with varimax rotation drawing seven factors. The factors cumulatively explained 59 % of the variance in the survey and the result was acceptable.

Thirty-three participants answered twice to the questionnaire. For the 35 items, an ICC ranged from 0.30 to 0.94. Twenty-nine items had an ICC above 0.70, five items had an ICC between 0.50 and 0.70 and one item had an ICC under 0.50 (Table 2).

The inter-correlations of the 11 dimensions, and correlations between the scale scores were also calculated. No dimension had high correlations above 0.80, with other dimensions. "*Communication Openness"* and "*Patient Counseling"* (r = 0.74) was most correlated, while "*Staffing, Work Pressure, and Pace"* and *"Overall Perceptions of Patient Safety "*(r = 0.01) was least correlated. The highest intercorrelations was 0.78 between *"Communication Openness" a*nd the scale (r = 0.78). The correlation between each dimension and the total scale were significantly different (Table 5).

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Table 5 Correlation with the total scale and inter-correlations of the 11 dimensions

Dimensions	1	2	3	4	5	6	7	8	9	10	11	Total
1 Physical Space and Environment	1.00	0.15	0.12	0.27	0.25	0.22	0.26	0.22	0.73	0.61	0.15	0.14*
2. Teamwork		1.00	0.12	0.44	0.30	0.28	0.31	0.28	0.64	0.55	0.15	0.14*
3. Staff Training and Skills			1.00	0.39	0.34	0.33	0.44	0.33	0.56	0.44	0.09	0.16*
4. Communication Openness				1.00	0.74	0.63	0.37	0.57	0.37	0.36	0.03	0.78*
5. Patient Counseling					1.00	0.70	0.70	0.70	0.20	0.02	0.05	0.76*
6. Staffing, Work Pressure, and Pace						1.00	0.68	0.69	0.02	-0.05	0.01	0.77*
7. Communication About Prescriptions Across Shifts							1.00	0.68	0.20	0.05	0.07	0.75*
8. Communication About Mistakes								1.00	0.20	-0.05	0.10	0.77*
9. Response to Mistakes									1.00	0.32	0.04	0.17*
10. Organizational Learning—Continuous Improvement										1.00	0.12	0.18*
11. Overall Perceptions of Patient Safety											1.00	0.13*

*All correlations are significant at P < 0.001

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Finally, table 6 presented the factor loadings for each item (all loadings > 0.30). Factor one loadings on five dimensions, and factor two loading on three dimensions *("Physical Space and Environment", "Teamwork"* and "*Staff Training and Skills"),* and factor three on "*Overall Perceptions of Patient Safety".*

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Table 6 Factors loading in each item

Items	*1*	*2*	*3*	*4*	*5*	*6*	*7*
A1. This pharmacy is well organized.		0.78					
A5. This pharmacy is free of clutter		0.55					
A7. The physical layout of this pharmacy supports good workflow.		0.72					
A2. Staff treat each other with respect.		0.82					
A4. Staff in this pharmacy clearly understand their roles and responsibilities.		0.47					0.30
A9. Staff work together as an effective team.		0.80					
A10. Technicians in this pharmacy receive the training they need to do their jobs		0.41					
A11. Staff in this pharmacy have the skills they need to do their jobs well.		0.41					
A12. Staff who are new to this pharmacy receive adequate orientation		0.66					
B1. Staff ideas and suggestions are valued in this pharmacy	0.73						
B4. Staff feel comfortable asking questions when they are unsure about something	0.97						
B5. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns in this pharmacy.	0.95						
B2. We encourage patients to talk to pharmacists about their medications.	0.96						
B7. Our pharmacists spend enough time talking to patients about how to use their medications	0.96						
B11. Our pharmacists tell patients important information about their new prescriptions	0.61						
B3. Staff take adequate breaks during their shifts	0.73						
B9. We feel rushed when processing prescriptions. (negatively worded)	0.92						
B12. We have enough staff to handle the workload.	0.61						
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)	0.94						
B1. We have clear expectations about exchanging important prescription information across shifts	0.73						
B6. We have standard procedures for communicating prescription information across shifts.	0.72						
B14. The status of problematic prescriptions is well communicated across shifts	0.96						
B8. Staff in this pharmacy discuss mistakes.	0.74						
B13. When patient safety issues occur in this pharmacy, staff discuss them.	0.60						
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.	0.53						
C1. Staff are treated fairly when they make mistakes				0.92			
C4. This pharmacy helps staff learn from their mistakes rather than punishing them			0.65				
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.			0.68				
C8. Staff feel like their mistakes are held against them. (negatively worded)			0.41		0.54		
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.					-0.75		
C5. When the same mistake keeps happening, we change the way we do things			0.69				
C10. Mistakes have led to positive changes in this pharmacy				0.91			
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)			-0.71				
C6. This pharmacy is good at preventing mistakes.		0.39	0.71				
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.			0.43			0.33	-0.35

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Discussion

The study is the first publication of its kind using the PSOPSC to explore patient culture in hospital pharmacy sector. It is, furthermore, the first Chinese study to report data on perspectives of patient culture in different levels of qualification and hospital in pharmacy setting. The PSOPSC has been introduced by AHRQ for about one year which was only conducted for pilot study in US pharmacies.[20] We adopted this survey in our research, because we take the consideration that this is a very comprehensive patient safety culture survey focused on the pharmacy sector which is best suitable for examining patient safety climate from a hospital pharmacy perspective. Moreover, the survey will enable the pharmacies to assess areas of strength and identify areas for improvement in their patient safety culture as part of their quality improvement activities.

In our study, the response rate was 84% which was higher than the pilot study implemented in US (75%).[20] A high response rate on a questionnaire about safety attitudes might be a measure of the staff 's attentiveness to these issues.[22] Overall, the mean positive response rate for the 11 patient safety culture dimensions of the PSOPSC survey was 71%, slightly higher than the other two studies conducted in Taiwan by Chen 2012[23]and the mainland of China by Nie 2013.[4] Comparing with these two studies, we found that the three studies have a common feature that they predominantly used surveys to assess individual attitudes covering areas related to work environment, adherence to guidelines and safety concerns.[24] The only difference is that Chen and Nie used the Hospital Survey on Patient Safety Culture (HSPSC) for all health care workers within organizational level ,while we

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used PSOPSC for hospital pharmacy workers which thereby, elicits a snapshot of the safety climate in the specific setting. Meanwhile, in some other studies, the pharmacists surveyed were relatively in a small size in their study populations, such as the HSPSC study in Japan by Shinya Ito, 155(2.4%) pharmacists were included,[11] and the HSPSC study in US by Joann S Sorra, 1215(2%) pharmacists were included.[12]

Our study found that there was substantial variability in the percent of positive scores across 11 dimensions. The dimension "*Staff Training and Skill"*appeared to receive the highest positive response rate (88%). An explanation for this might be the fact that the national job training project for pharmacists in China named *'Clinical Pharmacist pilot Training'* for a long time put great effort into providing clinical pharmacy training for pharmacists who are working or will work as clinical pharmacists from different hospitals.[25] But another possible reason is that the relatively high proportion of positive responses might be that the translation was inadequate, and that a ceiling effect occurred.[10] Simultaneously, the dimension "*Teamwork"* received a positive response rate of 84% in our study,which is similar to the studies reported by Belgium,[14] Turkey,[26] Swedish,[10] US,[27], China[4] and Taiwan[23] (70%,76%,78%,80%,84%,and 94% ,respectively). The interpretation of the results within a given setting is that if ⩾ 80% of the respondents report positive assessments on a specific item or set of items, then there is a strong positive consensus in that setting.[10] A score of less than 60% is considered to be in the "needs improvement," range.[10] Hence, ⩾60% is a threshold for which safety climate can be considered acceptable. Hooly, we can conclude that the

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respondents were delight in cooperating with others and well functioning relative to hospital departments.

This study displayed that both in China and US, the dimensions that received the lowest positive rate was *"Staffing, Work Pressure, and Pace"*(50% and 41%, respectively),indicating that the respondents feel that staff allocation is not adequate to handle patient safety related workload.[4] Our results are according with those reported by Hellings and the study conducted in Taiwan and China. [4,14,23,28] Meanwhile, a study by Elisa E in Northern California hospital of US showed that the most common causes of medication errors were high workload (25.3%), fatigue or lack of sleep (16.5%).[29] Therefore it is important for pharmacy to allocate staffs and working hours more adequately to reduce the medication errors and improve patient safety. In addition, in our study, another relatively low positive response rate was the dimension *"Patient Counseling"* (57%) which reflected the problem in China: poor doctor-patient communication. A study by Zou in China indicated that 49% medical lawsuits related to poor doctor-patient communication.[30] A study by Moore P showed that of 635 complaints involved a doctor, 49 cases (15%) were because of "Lack of communication".[31] Lack of 'communication openness' was identified as a major safety culture problem. In other words, communication openness was seriously jeopardised by the lack of trust between health workers and patients in China reported by Liu in the recent study.[32]

The results showed that the positive response numbers of Third-grade hospital regarding patient safety culture was higher than that of Second-grade hospital. The reason account for this may

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be that in China, the Third-grade hospital always manage severe clinical cases so the pharmacies of Third-grade hospital have a higher potential for life-threatening medical errors. As most risky medical interventions take place in these hospitals, the staff have to get better training to deal with in safety-related issues.[26] Simultaneously, our study found that the positive response rate of pharmacists with high qualification (senior pharmacists) was higher than those with low qualification level (junior pharmacists) on the dimension *"Staffing, Work Pressure, and Pace"*. Seniority has been found to bring about experience,[22] as they know the pitfalls of the pharmacy work and can avoid them masterly which might reduce the risk for error making, so senior pharmacists might work more effectively and had a positive attitude to their work pressure. This was also elucidated in the study by Sorlie V that the more experience physicians gained, the more confident they would feel.[33] So we can infer that the experiential proficiency is a prerequisite to this higher positive response.

The pharmacy is an important link between the patient and medication, so developing a culture of safety has become one of the pillars of the pharmacy. According to the report of China Food and Drug Administration(CFDA), a total of 852,799 drug adverse events happened in China in 2011.[7] Chinese Hospital Association (CHA) estimated that adverse events affect 1.6 ~ 7.6 million hospitalizations annually in Chinese hospitals.[34] A study by Li,XL showed that 1165 medication errors reported by 22 hospitals in Beijing in 2012[35]and another study by Li,XY in China indicating that 32 (26.30%) dispensing errors were applied to the pharmacists and 5 (4.03%) dispensing errors were related to the environment of the pharmacy.[36] The adaptation of this instrument to the Chinese

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pharmacy context not only is an important milestone for safety research in pharmacies but also provides the pharmacies with an instrument that generates diagnostic and actionable information for pharmacies and leaders to use in guiding improvement efforts.[37] The findings of the study illustrated that the pharmacies and health care organizations in China should have imperatives to develop strategies to improve pharmacy service quality and ensure patient safety. These strategies include: strengthen patient safety training for pharmacy staffs, reasonable allocate staff and workload, creating an environment conducive to reporting errors by focusing on the process or system failure instead of the individual who committed the error.[38] What's more, we should raise awareness of the important of patient engagement in improving medication safety because a global concerted effort is need to address medication safety and it needs the involvement of all health-care stakeholders, including patient. In addition, building trust between providers and patients and between managers and health workers is essential for empowering health workers to address patient safety issues.[32]

Reliability

Using Cronbach's a, all subscales had acceptable levels of reliability, which varied from 0.84 for "*Communication About Prescriptions Across Shifts"* to 0.44 for "*Teamwork",* with the exception of the dimension "*Communication about Mistakes*" which had the lowest value 0.17. The results were less satisfactory as compared to AHRQ data.[20] The dimension "*Communication about Mistakes*" received the lowest Cronbach's a among the 11 dimensions, three reasons could account for this.Firstly, a possible explanation was the translation, scale should not be translated and applied in

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another setting of a different cultural context directly.[4] Secondly, factor structure of the PSOPSC model for these items might not fit the data well.[23] Thirdly, the sample size of the data might not be large enough to achieve consistency.[23] But, the low reliability also suggested the instability of the aspects measured by the questionnaire, which are based on professionals' perceptions of safety (themselves linked to safety circumstances at a given time, and inherently instable and subject to change). If culture does not change so rapidly, perceptions do.[21]

Conclsion

The results demonstrated that among the pharmacy staff surveyed in China there was a positive attitudes towards patient safety culture in their organizations. The Chinese translation of PSOPSC questionnaire (version 2012) used in our study was acceptable.

Footnotes

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Contributors

MMZ conceptualized and designed the study. PLJ and LHZ performed and interpreted the data analysis. MMZ and PLJ drafted and revised the manuscript critically for intellectual content. The rest of authors did data collection and checked data input. All authors read and approved the final

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Competing interests

None

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Data sharing statement

No additional data are available.

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Safety Culture in Pharmacy Setting Using Pharmacy Survey on Patient Safety Culture: A Cross-sectional Study in China

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Abstract

Objective To explore the attitudes and perceptions of patient safety culture for pharmacy workers in China by using a Pharmacy Survey on Patient Safety Culture (PSOPSC), and to assess the psychometric properties of the translated Chinese-language version of the PSOPSC.

Design Cross-sectional study.

Participants Data were obtained from 20 hospital pharmacies in southwest part of China.

Method Chi-Square test was performed to explore the differences on pharmacy staff in different hospital and qualification levels and countries towards patient safety culture. We also computed descriptive statistics, internal consistency coefficients and inter-subscale correlation analysis, then conducted a exploratory factor analysis. A test–retest was performed to assess reproducibility of the items.

Result A total of 630 questionnaires were distributed of which 527 were responded validly (response rate 84 %). The positive response rate for each item ranged from 37% to 90%. The positive response rate on three dimensions ("*Teamwork", "Staff Training and Skills"* and "*Staffing, Work Pressure, and Pace"*) was higher than that of Agency for Healthcare Research and Quality(AHRQ) data ($P<0.05$). There was a statistical difference on the perception of patient safety culture in different hospital and qualification levels. The internal consistency of the total survey was comparatively satisfied (Cronbach's $\alpha=0.89$).

Conclusion The results demonstrated that among the pharmacy staffs surveyed in China,there was a positive attitudes towards patient safety culture in their organizations. Identifying perspectives of patient safety culture from pharmacists in different hospital and qualification levels are

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important,since this can help support decisions about action to improve safety culture at pharmacy settings. The Chinese translation of PSOPSC questionnaire (version 2012) applied in our study is acceptable.

Strengths and limitations of this study

- This is the first kind of study that was conducted in China measuring patient safety culture in pharmacy setting. The results of this study may provide some evidence to help healthcare decision makers or policy makers in pharmacy settings from developing countries to develop effective strategies to assess areas of strength and identify areas for improvement in their patient safety culture as part of their quality improvement activities.
- Findings might be limited by selection bias as pharmacies were selected on a convenient basis. Our study was carried out only in the Second-grade and Third-grade hospitals which may not reflect the whole picture of patient safety culture in China. Meanwhile, this is the first kind of study using PSOPSC to measure safety culture in pharmacy setting, there are no similar studies from benchmark scores using PSOPSC for us to compare with, so the external comparison was restrictive. Finally, because of small sample numbers included in our study and because our primary objective is to explore the attitudes and perceptions of patient safety culture for pharmacy workers, we did not conduct confirmatory factor analysis to test hypotheses about a particular factor structure.

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Background

Medication errors are the largest component of medical errors accounting for about a quarter of the incidents which threaten patient safety.[1] An estimated 770000 people are injured or die in hospitals from adverse drug events(ADEs) each year which are injuries resulting from drug use. Approximately 28% of ADEs are associated with a medication error and therefore are judged to be preventable.[2] Fifty percent of these ADEs could have been prevented by a pharmacist.[3] It appears that pharmacists and clinical pharmacy services can substantially improve patient safety and reduce hospital costs associated with medication errors.[1] Meanwhile, the report by Institute of Medicine (IOM) indicated for a safety culture in which adverse events can be reported without people being blamed, and that when mistakes occur that lessons are learned.[4] Therefore, if hospital pharmacies want to improve patient safety, it is important to know more about the views of their staff in relation to the culture of patient safety.

Today, reducing medication errors and improving patient safety have become common topics of health services around the world.[5] Many developed countries have initiated the research into the role played by patient safety culture research. On a global basis, several international organizations promote the establishment of a culture of patient safety: the WHO Patient Safety Programme will launch in 2014 the Third Global Patient Safety Challenge, focusing on medication safety, the National Patient Safety Agency in the UK, the Agency for Healthcare Research and Quality in US, The Australia Commission of Safety and Quality, and The European Foundation for the Advancement of Healthcare Practitioners.[4,6] There are some developing countries that are oblivious to the problems created by medication errors. However, efforts are now being taken in these countries, especially India, China and Philippines, to set up pharmacovigilance system for collection of information on

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ADEs.[6-8]

As pharmacies continually strive to improve safety and quality, there is a growing recognition of the importance of establishing a culture of patient safety. Achieving such a culture requires an understanding of the values, and beliefs about what is important in the organization and what attitudes and behaviors related to patient safety are expected.[9] The assessment of safety culture in pharmacies has recently begun to develop and the consistency of methods and instruments used across pharmacies needs to be further elaborated.[10] Quite often, hospital pharmacies have been included in overall hospital based safety culture assessments.[11-16] There are a few studies of pharmacy survey on patient safety culture by using different scales.[10,17-19] However, most of these studies focused on the evaluation of the psychometric properties of the scales or on developing, and examining the component structure and internal consistency of the survey instruments.[10,18,19] E.g. the study by Ashcroft aims to develop a Pharmacy Safety Climate Questionnaire (PSCQ) and examine the component structure and internal consistency in the community pharmacy setting in England.[19] Nevertheless, no study to date, to our knowledge, using survey developed for pharmacists has been published in which the safety culture in hospital pharmacies has been assessed.

In this study, the patient safety culture in China's hospital pharmacies were measured by using the modified version of Pharmacy Survey on Patient Safety Culture (PSOPSC) developed by AHRQ (version 2012).[9] We also compared some of the findings with existing data from the AHRQ pilot study. Meanwhile, we intended to assess the quality of this investigative questionnaire.

Methods

Questionnaire

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The Pharmacy Survey on Patient Safety Culture (PSOPSC) was translated and modified to suit the Chinese system. The original PSOPSC was developed by AHRQ in 2012 on the purpose of pilot study which was designed to assess 11 dimensions of pharmacy with 36 items of patient safety culture.[9] The questionnaire also included three questions that ask respondents to rate the frequency with which mistakes were documented and one question that provides an overall rating on patient safety.[20] Additionally, the original PSOPSC contained a section of *"Background Questions"* as well as an open ended section. We made a slight emendation of PSOPSC questionnaire by combining two items—(A3:"*Technicians in this pharmacy receive the training they need to do their jobs"* and A10: " *Staff get enough training from this pharmacy"*) into one item because they were almost the same meaning in Chinese translation. Furthermore, we added two items to the section *"Background Questions"*—(gender and hospital levels) and refreshed the qualification categories to adapt to Chinese context. (see online supplementary table)

The survey used either 5-point agreement scales ("Strongly disagree" to "Strongly agree") or frequency scales ("Never" to "Always"). Items include a "Does not apply or Don't know" option.[20]

The permission to use and translate PSOPSC was obtained from AHRQ. We did not use "translation-back translation techniques",because we were informed by our language experts that "translation-back translation techniques" was a good approach for some languages especially for Latin language system, however it may not be one of the best approaches for the Chinese translation which was totally different language system. The Chinese translation was carried out in several steps. First, the recommended guideline of PSOPSC: *User's Guide* was carefully discussed within the research group before translation. The first translation was done by a graduate medical student with background in patient safety. Then, the translation was double checked and reviewed by the research

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group including experts in pharmacy, methodologists, and English. Finally, we pre-rest the translation in the pilot investigation among 30 pharmacy staff for further improvement before formal investigation. We had a further discussion regarding to some wordings and especially on some items that would cause misunderstanding in Chinese language. (e.g.the items of *"We feel rushed when processing prescriptions","Staff feel like their mistakes are held against them","Staff feel comfortable asking questions when they are unsure about something" and the last section of "Documenting Mistakes"*).

Sample

Convenient sampling was used to survey hospital pharmacies (one of the hospial departments) throughout southwest part of China. The self-administered questionnaire was conducted over six months from March through August 2013 with 20 hospital pharmacies included(pharmacy workers ranging from 30 to 60 in each hospital).We involved in all pharmacy staff working in the pharmacy area where prescriptions were dropped off, filled, dispensed, and picked up or prepared for delivery.[9] The pharmacy staff consisted of senior pharmacists (at least three years university education and working time must more than 9 years in the pharmacy), junior pharmacists (at least three years university education and working time is less than 9 years in the pharmacy) and pharmacy intern who was still undergraduate and just work in a pharmacy in spare time.

To ensure the privacy of the respondents, the survey was strictly anonymous. Permission to conduct the investigation was granted by the hospital pharmacy directors before investigation. The participants were informed of the purpose of the survey and voluntarily completed a paper copy of the questionnaire by the research coordinators in different hospitals.

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Data screening and collection

After receiving the completed questionnaires, a preprocessing step was applied to remove incomplete or invalid data and based on the study by Hellings J.[14] We checked and examined the returned questionnaire. The exclusion criteria were similar to two studies: 1) there was no entire section completed; 2) there was fewer than half items answered or all the items answered the same.[4,14] All data was entered by two researchers (Jia PL and Zhang LH) independently, and then were cross-checked mutually by Epidata (version, 3.02). In case of doubts or disagreement in some answers, we looked into the original questionnaires. Negatively worded items were reversed to ensure that positive answers indicated a higher score. Most of the items in the questionnaire used the Likert 5- point response scale of agreement (Strongly disagree to Strongly agree) or frequency (Never to Always), so the lowest three scoring(1-3) answers (Strongly disagree/Disagree/Neither Agree nor Disagree or Never/Rarely/Sometimes), the highest two scoring (4-5) answers(Agree /Strongly agree or Most of the time/Always), as well as the highest two scoring answers were perceived as positive response answers, and the lowest three scoring answers were deemed other response answer. We calculated the positive response rate according to the formula by the User's Guide of PSOPSC.[9] Items marked as "Does Not Apply/Don't Know" response option by the respondents were excluded when displaying percentages of response and the positive response scores.[9]

Data analysis

We analyzed the demographic characteristics using the Excel 2007. The number of positive response/positive response rate of all the items was also summarized. Positive response rate was used to evaluate the attitudes towards patient safety culture on different dimensions or items. We aggregated the results across all 20 pharmacies by looking at agreement indices .We used Chi-Square

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test to compare whether there was a statistical difference on pharmacy staff in hospital and qualification levels towards patient safety culture. A Chi-squared test was also used to infer if there was a statistical difference on *"patient safety grade"* in Chinese pharmacies compared with that of US pharmacies, with the significant level of $P = 0.05$.

We calculated Cronbach's a and exploration factor analysis to evaluate the quality of the questionnaire. Internal consistency value (Gronbach's $\alpha \geq 0.70$) for newly developed scales was recommended.[4] Structure validity was explored using principal component factor analysis by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO> 0.7) and by Bartlett's Test of Sphericity $P < 0.05$.

Intercorrelations among 11 dimensions were calculated using the non-parametric Spearman test as it is adapted to qualitative ordinal variables. The correlations should be less than 0.8 for the composites to be considered unique and avoid problems with multicollinearity.[12]

A test–retest was administered in a specialized hospital to assess the reproducibility. Thirty-three randomly selected pharmacy staff were asked to answer the questionnaire twice with a 2-week interval between the test and the retest. Test–retest reliability was assessed by the one-way intra-classcorrelation coefficient (ICC type (1, 1).[21] Reliability was considered good if ICC was greater than 0.70.[21]

Ethic

This was a non-interventional survey.We were informed that no required from the ethics committee needed this time by the hospital ethics committee. However, responding to the questionnaire was voluntary and all answers were de-identified to maintain confidentiality.

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Results

Sample and response statistics

A total of 630 questionnaires were distributed of which 527 were responded validly (84%). Three hundred and seventy nine (72%) of the respondents were female, 421 (80%) were junior pharmacists, followed by pharmacy interns (16%) and senior pharmacists (4%). The majority of the respondents (68%) was from Third-grade hospitals (Table 1).

Table 1 Demographic characteristics of respondents

Characteristics	Senior pharmacist (n = 20)	Junior pharmacist (n = 421)	Pharmacy intern (n = 86)	Total (n = 527)
Sex				
Male	4(2.7)	115(77.7)	29(19.6)	148(100[a])
Female	16(4.2)	306(80.8)	57(15.0)	379(100)
Working time in hospital				
Less than 6 months	3(5.6)	40(74.1)	11(20.4)	54(100)
6 months to less than 1 year	5(6.4)	57(73.1)	16(20.5)	78(100)
1 to 3 years	5(4.0)	104(83.9)	15(12.1)	124(100)
3 to 6 years	3(3.0)	82(81.2)	16(15.8)	101(100)
6 to 12 years	1(1.4)	55(77.5)	15(21.5)	71(100)
12 years or more	3(3.0)	83(83.8)	13(13.1)	99(100)
Working hours per week				
1 to 16 hours	0(0)	14(87.5)	2(12.5)	16(100)
17 to 31 hours	1(4.5)	18(81.8)	3(13.6)	22(100)
32 to 40 hours	14(4.7)	244(73.2)	42(14.0)	300(100)
More than 40 hours	5(2.6)	145 (76.8)	39(20.6)	189(100)
Hospital level [b]				
Third-grade hospital	14(3.9)	290(81.2)	53(14.8)	357(100)
Second-grade hospital	6(3.5)	131(77.1)	33(19.4)	170(100)

[a] Parenthesis represent percentage

[b] Third-grade hospital: provincial and municipal hospital
Second-grade hospital: reginal hospital

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In our study, the percentage of positive responses for the 11 patient safety culture dimensions ranged from 50% to 88%, the mean positive response rate was 71%. The lowest positive response rate of dimension was *"Staffing, Work Pressure, and Pace"* (50%), while the highest positive response rate of dimension was "*Staff Training and Skills"* (88%). There were two dimensions of which positive response rate were less than 60% such as "*Patient Counseling"*(57%), and "*Staffing,Work Pressure, and Pace"* (50%). The positive response rate for the rest of the items ranged from 37% to 90%. The highest positive response rate of the three items reached 90% , while the lowest positive response rate of the item was "*Staff feel like their mistakes are held against them"*(37%)(Table 2).

However, the 2012 Preliminary Comparative Results: PSOPSC in US showed that the average positive response rate of 11 dimensions ranged from 41% to 90%, the overall average positive response rate for dimensions was 78%. The lowest positive response rate of item was "*We feel rushed when processing prescriptions"*(14%) and the highest positive response rate item was"*Our pharmacists tell patients important information about their new prescriptions"* (93%).There were 4 items of which the positive response rate were less than 60% (Table 2).

There were some differences (in the original version of U.S. PSOPSC, the A3:"*Technicians in this pharmacy receive the training they need to do their jobs"* and A10: " *Staff get enough training from this pharmacy"* are seperate items, in our modified Chinese version, we combined the two items into a single item because they were almost the same meaning in Chinese translation.) between the adapted Chinese PSOPSC with that of original US PSOPSC, so only the same items were compared to explore the differences of perceptions towards patient safety culture between the two countries. The results showed that there was a significant difference on three items ($P < 0.05$) of which the positive response rate on three items in China was higher than that of the US. These dimensions were (1) *Teamwork, (2) Staffing, Work Pressure, and Pace.* However, there was a significant difference on 18 items ($P < 0.05$), which of the positive response rate on 18 items in China was lower than that of the US (Table 2)

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Table2 Positive response rate of each item , Cronbach's α for dimensions and reproducibility

Dimension/items(internal consistency reliability coefficient)	US	China	ICC
1 Physical Space and Environment (Cronbach's α=0.60)	72%	69%	
A1. This pharmacy is well organized.	84%	84%	0.86
A5. This pharmacy is free of clutter	67%	53%	0.80
A7. The physical layout of this pharmacy supports good workflow.	65%	69%	0.69
2. Teamwork (Cronbach's α=0.44)	81%	84%	
A2. Staff treat each other with respect.	79%	86%	0.74
A4. Staff in this pharmacy clearly understand their roles and responsibilities.	81%	90%	0.86
A9. Staff work together as an effective team.	82%	77%	0.80
3. Staff Training and Skills(Cronbach's α=0.75)	79%	88%	
A3. Technicians in this pharmacy receive the training they need to do their jobs	81%	87%	0.78
A6. Staff in this pharmacy have the skills they need to do their jobs well.	86%	90%	0.86
A8. Staff who are new to this pharmacy receive adequate orientation	72%	88%	0.86
4. Communication Openness(Cronbach's α=0.57)	87%	64%	
B1. Staff ideas and suggestions are valued in this pharmacy	81%	64%	0.30
B5. Staff feel comfortable asking questions when they are unsure about something	91%	72%	0.88
B10. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns	88%	57%	0.52
5. Patient Counseling(Cronbach's α=0.69)	90%	57%	
B2. We encourage patients to talk to pharmacists about their medications.	92%	56%	0.80
B7. Our pharmacists spend enough time talking to patients about how to use their medications	86%	52%	0.94
B11. Our pharmacists tell patients important information about their new prescriptions	93%	63%	0.73
6. Staffing, Work Pressure, and Pace(Cronbach's α=0.50)	41%	50%	
B3. Staff take adequate breaks during their shifts	56%	60%	0.92
B9. We feel rushed when processing prescriptions. (negatively worded)	14%	40%	0.81
B12. We have enough staff to handle the workload.	56%	62%	0.92
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)	40%	37%	0.72
7. Communication About Prescriptions Across Shifts(Cronbach's α=0.84)	81%	79%	
B4. We have clear expectations about exchanging important prescription information across shifts	84%	83%	0.79
B6. We have standard procedures for communicating prescription information across shifts.	78%	77%	0.72
B14. The status of problematic prescriptions is well communicated across shifts	81%	77%	0.76
8. Communication About Mistakes(Cronbach's α=0.17)	79%	62%	
B8. Staff in this pharmacy discuss mistakes.	74%	50%	0.93
B13. When patient safety issues occur in this pharmacy, staff discuss them.	84%	57%	0.73
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.	81%	78%	0.68
9. Response to Mistakes (Cronbach's α=0.57)	79%	65%	
C1. Staff are treated fairly when they make mistakes	80%	81%	0.71
C4. This pharmacy helps staff learn from their mistakes rather than punishing them	84%	66%	0.84
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.	84%	76%	0.86
C8. Staff feel like their mistakes are held against them. (negatively worded)	69%	37%	0.66
10. Organizational Learning—Continuous Improvement(Cronbach's α=0.48)	83%	84%	
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.	90%	90%	0.74
C5. When the same mistake keeps happening, we change the way we do things	82%	81%	0.71
C10. Mistakes have led to positive changes in this pharmacy	79%	82%	0.76
11. Overall Perceptions of Patient Safety (Cronbach's α=0.45)	84%	80%	
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)	80%	79%	0.73
C6. This pharmacy is good at preventing mistakes.	85%	76%	0.94
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.	86%	84%	0.68

ICC, intra-class correlation coefficient

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Comparative results

The results showed that there was a significant difference on seven dimensions between Third-grade hospital and Second-grade hospital ($P < 0.05$). The positive response rate of five items of Third-grade hospitals was lower than that of Second-grade hospitals: (1) *This pharmacy is free of clutter* (2) *Our pharmacists spend enough time talking to patients about how to use their medications* (3) *Staff take adequate breaks during their shifts* (4)*We feel rushed when processing prescription* (5) *Interruptions/distractions in this pharmacy make it difficult for staff to work accurately"* ($P < 0.05$). The positive response rate of other items of Third-grade hospitals was higher than that of Second-grade hospitals (Table 3).

Incidence of patient safety events was closely related to the qualification levels of pharmacists. Our results showed that there was a significant difference in the positive response rate on two dimensions("*Staffing, Work Pressure, and Pace"*and "*Communication About Prescriptions Across Shifts",* $P<0.05$) for senior pharmacists, junior pharmacists and pharmacy intern. Furthermore, the positive response rate of pharmacists with high qualification(senior pharmacists) was higher than those with low qualification level (junior pharmacists) on the two items: "*Staff take adequate breaks during their shifts"*and "*We have standard procedures for communicating prescription information across shifts"* $P<0.05$ (Table 3).

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able 3 The comparison of attitudes of different levels of hospitals and qualification of hospital pharmacists on patient safety culture

Items	Hospital Levels						Qualification Levels				
	Third-grade Hospital		Second-grade Hospital		χ^2	*p*	Senior Pharmacist		Junior Pharmacist		Pharm Inte
	NPR	NOR	NPR	NOR			NPR	NOR	NPR	NOR	NPR
organized.	316	41	123	47	21.63	0.000	18	2	355	66	66
of clutter	171	186	107	63	10.45	0.001	12	8	223	198	43
this pharmacy supports good workflow.	236	121	123	47	2.07	0.15	16	4	288	133	55
with respect.	308	49	141	29	1,01	0.31	18	2	360	61	71
clearly understand their roles and responsibilities.	321	36	150	27	0.34	0.56	19	1	312	49	80
an effective team.	283	74	116	54	7,63	0.006	16	4	321	100	62
armacy receive the training they need to do their jobs	308	49	139	31	1.82	0.18	14	6	353	68	73
have the skills they need to do their jobs well.	319	38	150	27	0.15	0.70	19	1	376	45	74
his pharmacy receive adequate orientation	309	48	144	26	0.33	0.57	17	3	360	61	76
tion are valued in this pharmacy	220	137	101	69	0.24	0.63	16	4	253	168	52
asking questions when they are unsure about something	255	102	110	60	2.45	0.12	17	3	289	132	59
speak up to their supervisor/ manager about patient safety concerns in this pharmacy.	193	164	92	78	0.000	0.99	9	11	232	189	44
s to talk to pharmacists about their medications.	192	165	87	83	0.31	0.58	14	6	217	204	48
l enough time talking to patients about how to use their medications	274	83	137	33	0.99	0.32	13	7	231	208	46
patients important information about their new prescriptions	214	143	94	76	1.03	0.31	12	8	247	174	49
eaks during their shifts	187	170	121	49	16.75	0.000	18	2	245	176	45
processing prescriptions. (negatively worded)	110	247	87	83	20.40	0.000	8	12	153	268	36
f to handle the workload.	212	145	202	68	0.02	0.89	15	5	251	170	48
ons in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for ly. (negatively worded)	116	241	71	99	4.32	0.04	6	14	147	274	34
tion about exchanging important prescription information across shifts	171	186	101	69	6.11	0.01	17	3	333	88	61
ced ures for communicating prescription information across shifts.	241	116	126	44	2.28	0.12	16	4	303	118	48
nati prescriptions is well communicated across shifts	257	100	126	44	0.26	0.61	18	2	307	114	58
discuss mistakes.	180	177	72	98	3.00	0.08	11	9	201	220	40
ssues occur in this pharmacy, staff discuss them.	208	149	84	86	3.65	0.06	11	9	233	188	48
talk about ways to prevent mistakes from happening again.	283	74	116	54	7.63	0.006	16	4	319	102	64
when they make mistakes	287	70	131	39	0.78	0.38	17	3	330	91	71
staff learn from their mistakes rather than punishing them	222	135	120	50	3.57	0.06	15	5	275	146	52
s and the way we do things to understand why mistakes happen in this pharmacy.	268	89	117	53	2.28	0.13	15	5	313	108	57
stakes are held against them. (negatively worded)	118	239	68	102	2.43	0.12	5	15	152	269	29
ens, we try to figure out what problems in the work process led to the mistake.	323	34	145	25	3.11	0.08	19	1	371	50	78
e keeps happening, we change the way we do things	291	66	127	43	3.25	0.07	18	2	335	86	65
positive changes in this pharmacy	298	59	118	52	13.70	0.000	16	4	337	84	63
more emphasis on sales than on patient safety. (negatively worded)	274	83	132	38	0.05	0.82	17	3	323	98	66
at preventing mistakes.	276	81	116	54	4.98	0.03	17	3	315	106	60
in this pharmacy reflects a strong focus on patient safety.	306	51	129	41	7.73	0.005	19	1	351	70	65
es the patient and could cause harm but does not,how often is it documented?	200	157	99	71	0.23	0.63	12	8	243	178	44
es the patient but has no potential to harm the patient, how often is it documented?	207	150	95	75	0.21	0.65	13	7	246	175	43
ould have harmed the patient is corrected before he medication, leaves pharmacy, ented?	209	148	95	75	0.33	0.56	14	6	244	177	41

ber of positive response answers; NOR,Number of other response

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Patient safety grade in China and the US and different qualification levels

The percentage of staff who rated the level of patient safety as "*good"*, "*very good*"or "*Excellent*" was 79% in our study, which was lower than the US score of 95%, there was a significant difference between the two groups (P<0.001). While there was no significant difference on "*Patient safety grade"* in different qualification levels (P=0.66) (Table 4). Meanwhile, there was a positive correlation between 11 dimensions on the PSOPSC and overall patient safety grade. All correlations were significant at P < 0.001. The correlation coefficient ranged from 0.30 to 0.46. In addition, there was also a positive correlation between scale and "*overall patient safety grade"*. The correlation coefficient was 0.43 and the correlation was significant at P < 0.001.

Table 4 The comparisons of patient safety grade between different position of hospital pharmacists

Patient safety grade	Senior Pharmacist (%)	Junior Pharmacist (%)	Pharmacy Intern(%)	China(%)	US(%)
Excellent	2[a](6.5)	25(80.6)	4(12.9)	84(16)	191(40)
Very good	1(1.2)	69(85.2)	11(13.6)	227(43)	211(44)
Good	6(5.6)	80(74.8)	21(19.6)	105(20)	53(11)
Fair	7(3.1)	184(81.4)	35(15.5)	79(15)	24(5)
Poor	4(4.9)	63(76.8)	15(18.30	32(6)	0

[a] number of the respondents

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Reliablity and validity

In our research, the Cronbach's alpha was of 0.89 for the questionnaire and ranged from 0.17 to 0.83 for dimensions. The dimension"*Communication About Mistakes"* had the lowest coefficients of 0.17 (Table 2). Yet in the US, the Cronbach's α was ranged from 0.68 to 0.89 for dimensions of which "*Staffing, Work Pressure, and Pace"* had the lowest values of 0.68.

Bartlett's test of the 35 items on patient safety culture demonstrated a sufficient inter-item correlation: $\chi^2 = 12037.98$, df = 595, $P < 0.01$. Furthermore, the Kaiser –Meyer-Olkin measure of sampling adequacy was satisfactory, with a value of 0.935. Explorative factor analysis was performed using principal component analysis with varimax rotation drawing seven factors. The factors cumulatively explained 59 % of the variance in the survey and the result was acceptable.

Thirty-three participants answered twice to the questionnaire. For the 35 items, an ICC ranged from 0.30 to 0.94. Twenty-nine items had an ICC above 0.70, five items had an ICC between 0.50 and 0.70 and one item had an ICC under 0.50 (Table 2).

The inter-correlations of the 11 dimensions, and correlations between the scale scores were also calculated. No dimension had high correlations above 0.80, with other dimensions. "*Communication Openness"* and "*Patient Counseling"* (r = 0.74) was most correlated, while "*Staffing, Work Pressure, and Pace"* and *"Overall Perceptions of Patient Safety "*(r = 0.01) was least correlated. The highest intercorrelations was 0.78 between *"Communication Openness" a*nd the scale (r = 0.78). The correlation between each dimension and the total scale were significantly different (Table 5).

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Table 5 Correlation with the total scale and inter-correlations of the 11 dimensions

Dimensions	1	2	3	4	5	6	7	8	9	10	11	Total
1 Physical Space and Environment	1.00	0.15	0.12	0.27	0.25	0.22	0.26	0.22	0.73	0.61	0.15	0.14*
2. Teamwork		1.00	0.12	0.44	0.30	0.28	0.31	0.28	0.64	0.55	0.15	0.14*
3. Staff Training and Skills			1.00	0.39	0.34	0.33	0.44	0.33	0.56	0.44	0.09	0.16*
4. Communication Openness				1.00	0.74	0.63	0.37	0.57	0.37	0.36	0.03	0.78*
5. Patient Counseling					1.00	0.70	0.70	0.70	0.20	0.02	0.05	0.76*
6. Staffing, Work Pressure, and Pace						1.00	0.68	0.69	0.02	-0.05	0.01	0.77*
7. Communication About Prescriptions Across Shifts							1.00	0.68	0.20	0.05	0.07	0.75*
8. Communication About Mistakes								1.00	0.20	-0.05	0.10	0.77*
9. Response to Mistakes									1.00	0.32	0.04	0.17*
10. Organizational Learning—Continuous Improvement										1.00	0.12	0.18*
11. Overall Perceptions of Patient Safety											1.00	0.13*

*All correlations are significant at P < 0.001

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Finally, table 6 presented the factor loadings for each item (all loadings > 0.30). Factor one loadings on five dimensions, and factor two loading on three dimensions *("Physical Space and Environment", "Teamwork"* and "*Staff Training and Skills"),* and factor three on "*Overall Perceptions of Patient Safety".*

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Table 6 Factors loading in each item

Items	*1*	*2*	*3*	*4*	*5*	*6*	*7*
A1. This pharmacy is well organized.		0.78					
A5. This pharmacy is free of clutter		0.55					
A7. The physical layout of this pharmacy supports good workflow.		0.72					
A2. Staff treat each other with respect.		0.82					
A4. Staff in this pharmacy clearly understand their roles and responsibilities.		0.47					0.30
A9. Staff work together as an effective team.		0.80					
A10. Technicians in this pharmacy receive the training they need to do their jobs		0.41					
A11. Staff in this pharmacy have the skills they need to do their jobs well.		0.41					
A12. Staff who are new to this pharmacy receive adequate orientation		0.66					
B1. Staff ideas and suggestions are valued in this pharmacy	0.73						
B4. Staff feel comfortable asking questions when they are unsure about something	0.97						
B10. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns in this pharmacy.	0.95						
B2. We encourage patients to talk to pharmacists about their medications.	0.96						
B7. Our pharmacists spend enough time talking to patients about how to use their medications	0.96						
B11. Our pharmacists tell patients important information about their new prescriptions	0.61						
B3. Staff take adequate breaks during their shifts	0.73						
B9. We feel rushed when processing prescriptions. (negatively worded)	0.92						
B12. We have enough staff to handle the workload.	0.61						
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)	0.94						
B1. We have clear expectations about exchanging important prescription information across shifts	0.73						
B6. We have standard procedures for communicating prescription information across shifts.	0.72						
B14. The status of problematic prescriptions is well communicated across shifts	0.96						
B8. Staff in this pharmacy discuss mistakes.	0.74						
B13. When patient safety issues occur in this pharmacy, staff discuss them.	0.60						
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.	0.53						
C1. Staff are treated fairly when they make mistakes				0.92			
C4. This pharmacy helps staff learn from their mistakes rather than punishing them			0.65				
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.			0.68				
C8. Staff feel like their mistakes are held against them. (negatively worded)			0.41		0.54		
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.					-0.75		
C5. When the same mistake keeps happening, we change the way we do things			0.69				
C10. Mistakes have led to positive changes in this pharmacy				0.91			
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)			-0.71				
C6. This pharmacy is good at preventing mistakes.		0.39	0.71				
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.			0.43			0.33	-0.35

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Discussion

The study is the first publication of its kind using the PSOPSC to explore patient culture in hospital pharmacy sector. It is, furthermore, the first Chinese study to report data on perspectives of patient culture in different levels of qualification and hospital in pharmacy setting. The PSOPSC has been introduced by AHRQ for about one year which was only conducted for pilot study in US pharmacies.[20] We adopted this survey in our research, because we take the consideration that this is a very comprehensive patient safety culture survey focused on the pharmacy sector which is best suitable for examining patient safety climate from a hospital pharmacy perspective. Moreover, the survey will enable the pharmacies to assess areas of strength and identify areas for improvement in their patient safety culture as part of their quality improvement activities.

In our study, the response rate was 84% which was higher than the pilot study implemented in US (75%).[20] A high response rate on a questionnaire about safety attitudes might be a measure of the staff 's attentiveness to these issues.[22] Overall, the mean positive response rate for the 11 patient safety culture dimensions of the PSOPSC survey was 71%, slightly higher than the other two studies conducted in Taiwan by Chen 2012[23]and the mainland of China by Nie 2013.[4] Comparing with these two studies, we found that the three studies have a common feature that they predominantly used surveys to assess individual attitudes covering areas related to work environment, adherence to guidelines and safety concerns.[24] The only difference is that Chen and Nie used the Hospital Survey on Patient Safety Culture (HSPSC) for all health care workers within organizational level ,while we

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used PSOPSC for hospital pharmacy workers which thereby, elicits a snapshot of the safety climate in the specific setting. Meanwhile, in some other studies, the pharmacists surveyed were relatively in a small size in their study populations, such as the HSPSC study in Japan by Shinya Ito, 155(2.4%) pharmacists were included,[11] and the HSPSC study in US by Joann S Sorra, 1215(2%) pharmacists were included.[12]

Our study found that there was substantial variability in the percent of positive scores across 11 dimensions. The dimension "*Staff Training and Skill"*appeared to receive the highest positive response rate (88%). An explanation for this might be the fact that the national job training project for pharmacists in China named *'Clinical Pharmacist pilot Training'* for a long time put great effort into providing clinical pharmacy training for pharmacists who are working or will work as clinical pharmacists from different hospitals.[25] But another possible reason is that the relatively high proportion of positive responses might be that the translation was inadequate, and that a ceiling effect occurred.[10] Simultaneously, the dimension "*Teamwork"* received a positive response rate of 84% in our study,which is similar to the studies reported by Belgium,[14] Turkey,[26] Swedish,[10] US,[27], China[4] and Taiwan[23] (70%,76%,78%,80%,84%,and 94% ,respectively). The interpretation of the results within a given setting is that if ⩾ 80% of the respondents report positive assessments on a specific item or set of items, then there is a strong positive consensus in that setting.[10] A score of less than 60% is considered to be in the "needs improvement," range.[10] Hence, ⩾60% is a threshold for which safety climate can be considered acceptable.

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This study displayed that both in China and US, the dimensions that received the lowest positive rate was *"Staffing, Work Pressure, and Pace"*(50% and 41%, respectively),indicating that the respondents feel that staff allocation is not adequate to handle patient safety related workload.[4] Our results are according with those reported by Hellings and the study conducted in Taiwan and China. [4,14,23,28] Meanwhile, a study by Elisa E in Northern California hospital of US showed that the most common causes of medication errors were high workload (25.3%), fatigue or lack of sleep (16.5%).[29] Therefore it is important for pharmacy to allocate staffs and working hours more adequately to reduce the medication errors and improve patient safety. In addition, in our study, another relatively low positive response rate was the dimension *"Patient Counseling"* (57%) which reflected the problem in China: poor healthcare worker (including pharmacy staff)-patient communication. A study by Zou in China indicated that 49% medical lawsuits related to poor healthcare worker-patient communication.[30] A study by Moore P showed that of 635 complaints involved a doctor, 49 cases (15%) were because of "Lack of communication".[31] Lack of 'communication openness' was identified as a major safety culture problem. In other words, communication openness was seriously jeopardised by the lack of trust between health workers and patients in China reported by Liu in the recent study.[32]

The results showed that the positive response numbers of Third-grade hospital regarding patient safety culture was higher than that of Second-grade hospital. The reason account for this may be that in China, the Third-grade hospital always manage severe clinical cases so the pharmacies of

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Third-grade hospital have a higher potential for life-threatening medical errors. As most risky medical interventions take place in these hospitals, the staff have to get better training to deal with in safety-related issues.[26] Simultaneously, our study found that the positive response rate of pharmacists with high qualification (senior pharmacists) was higher than those with low qualification level (junior pharmacists) on the dimension *"Staffing, Work Pressure, and Pace"*. Seniority has been found to bring about experience,[22] as they know the pitfalls of the pharmacy work and can avoid them masterly which might reduce the risk for error making, so senior pharmacists might work more effectively and had a positive attitude to their work pressure. This was also elucidated in the study by Sorlie V that the more experience physicians gained, the more confident they would feel.[33] So we can infer that the experiential proficiency is a prerequisite to this higher positive response.

The pharmacy is an important link between the patient and medication, so developing a culture of safety has become one of the pillars of the pharmacy. According to the report of China Food and Drug Administration(CFDA), a total of 852,799 drug adverse events happened in China in 2011.[7] Chinese Hospital Association (CHA) estimated that adverse events affect 1.6 ~ 7.6 million hospitalizations annually in Chinese hospitals.[34] A study by Li,XL showed that 1165 medication errors reported by 22 hospitals in Beijing in 2012[35]and another study by Li,XY in China indicating that 32 (26.30%) dispensing errors were applied to the pharmacists and 5 (4.03%) dispensing errors were related to the environment of the pharmacy.[36] The adaptation of this instrument to the Chinese pharmacy context not only is an important milestone for safety research in pharmacies but also

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provides the pharmacies with an instrument that generates diagnostic and actionable information for pharmacies and leaders to use in guiding improvement efforts.[37] The findings of the study illustrated that the pharmacies and health care organizations in China should have imperatives to develop strategies to improve pharmacy service quality and ensure patient safety. These strategies include: strengthen patient safety training for pharmacy staffs, reasonable allocate staff and workload, creating an environment conducive to reporting errors by focusing on the process or system failure instead of the individual who committed the error.[38] What's more, we should raise awareness of the important of patient engagement in improving medication safety because a global concerted effort is need to address medication safety and it needs the involvement of all health-care stakeholders, including patient. In addition, building trust between providers and patients and between managers and health workers is essential for empowering health workers to address patient safety issues.[32]

Finally, although patient safety activity is getting recognized in China, there have still many challenges and difficulties in implementation this activity. E,g, our initinal design was to include 1000 phymarcy stff from 50 hospitals across China. However, the hospitals where we investigated were very sensitive and they did not like to "open" their 'data' or they were concerned whether this would influence the reputation of hospitals. Therefore, each time, we needed to negotiate and explain our purpose to get the approval from relative responsible persons which was a very time consuming experience and making our survey last for about 6 months and which was also the reason why our sample size was not big enough. We wish this would be changed with the implemattion of patient

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safety activity in the country.

Reliability and validity

Using the explorative factor analysis drew 7 factors. The factors cumulatively explained 59 % of the variance in the survey and the result was acceptable. Using Cronbach's a, all subscales had acceptable levels of reliability, which varied from 0.84 for "*Communication About Prescriptions Across Shifts"* to 0.44 for "*Teamwork",* with the exception of the dimension "*Communication about Mistakes*" which had the lowest value 0.17. The results were less satisfactory as compared to AHRQ data.[20] The dimension "*Communication about Mistakes*" received the lowest Cronbach's a among the 11 dimensions, three reasons could account for this.Firstly, a possible explanation was the translation, scale should not be translated and applied in another setting of a different cultural context directly.[4] Secondly, factor structure of the PSOPSC model for these items might not fit the data well.[23] Thirdly, the sample size of the data might not be large enough to achieve consistency.[23] But, the low reliability also suggested the instability of the aspects measured by the questionnaire, which are based on professionals' perceptions of safety (themselves linked to safety circumstances at a given time, and inherently instable and subject to change). If culture does not change so rapidly, perceptions do.[21] Finally, unlike other similar studies published anywhere focused on tool evaluation or developing the survey tool, the primary objective of our study focused on "to explore the attitudes and perceptions of patient safety culture for pharmacy workers in China by using a Pharmacy Survey on Patient Safety Culture ", Hence, we did not conduct a confirmatory factor analysis to test

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hypotheses about a particular factor structure which might be a weakpoint in this study. However, we will take this into our consideration with larger sample size in our future study.

Conclsion

The results demonstrated that among the pharmacy staff surveyed in China there was a positive attitudes towards patient safety culture in their organizations. The Chinese translation of PSOPSC questionnaire (version 2012) used in our study was acceptable.

Footnotes

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Contributors

MMZ conceptualized and designed the study. PLJ and LHZ performed and interpreted the data analysis. MMZ and PLJ drafted and revised the manuscript critically for intellectual content. The rest of authors did data collection and checked data input. All authors read and approved the final manuscript.

Competing interests

None

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Data sharing statement

No additional data are available.

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Title page

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Abstract

Objective To explore the attitudes and perceptions of patient safety culture for pharmacy workers in China by using a Pharmacy Survey on Patient Safety Culture (PSOPSC), and to assess the psychometric properties of the translated Chinese-language version of the PSOPSC.

Design Cross-sectional study.

Participants Data were obtained from 20 hospital pharmacies in southwest part of China.

Method Chi-Square test was performed to explore the differences on pharmacy staff in different hospital and qualification levels and countries towards patient safety culture. We also computed descriptive statistics, internal consistency coefficients and inter-subscale correlation analysis, then conducted a exploratory factor analysis. A test–retest was performed to assess reproducibility of the items.

Result A total of 630 questionnaires were distributed of which 527 were responded validly (response rate 84 %). The positive response rate for each item ranged from 37% to 90%. The positive response rate on three dimensions ("*Teamwork", "Staff Training and Skills"* and "*Staffing, Work Pressure, and Pace"*) was higher than that of Agency for Healthcare Research and Quality(AHRQ) data ($P<0.05$). There was a statistical difference on the perception of patient safety culture in different hospital and qualification levels. The internal consistency of the total survey was comparatively satisfied (Cronbach's $\alpha=0.89$).

Conclusion The results demonstrated that among the pharmacy staffs surveyed in China,there was a positive attitudes towards patient safety culture in their organizations. Identifying perspectives of patient safety culture from pharmacists in different hospital and qualification levels are important,since this can help support decisions about action to improve safety culture at pharmacy settings. The Chinese translation of PSOPSC questionnaire (version 2012) applied in our study is

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acceptable.

Strengths and limitations of this study

- This is the first kind of study that was conducted in China measuring patient safety culture in pharmacy setting. The results of this study may provide some evidence to help healthcare decision makers or policy makers in pharmacy settings from developing countries to develop effective strategies to assess areas of strength and identify areas for improvement in their patient safety culture as part of their quality improvement activities.
- Findings might be limited by selection bias as pharmacies were selected on a convenient basis. Our study was carried out only in the Second-grade and Third-grade hospitals which may not reflect the whole picture of patient safety culture in China. Meanwhile, this is the first kind of study using PSOPSC to measure safety culture in pharmacy setting, there are no similar studies from benchmark scores using PSOPSC for us to compare with, so the external comparison was restrictive. Finally, because of small sample numbers included in our study, we did not conduct confirmatory factor analysis to test hypotheses about a particular factor structure.

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Background

Medication errors are the largest component of medical errors accounting for about a quarter of the incidents which threaten patient safety.[1] An estimated 770000 people are injured or die in hospitals from adverse drug events(ADEs) each year which are injuries resulting from drug use. Approximately 28% of ADEs are associated with a medication error and therefore are judged to be preventable.[2] Fifty percent of these ADEs could have been prevented by a pharmacist.[3] It appears that pharmacists and clinical pharmacy services can substantially improve patient safety and reduce hospital costs associated with medication errors.[1] Meanwhile, the report by Institute of Medicine (IOM) indicated for a safety culture in which adverse events can be reported without people being blamed, and that when mistakes occur that lessons are learned.[4] Therefore, if hospital pharmacies want to improve patient safety, it is important to know more about the views of their staff in relation to the culture of patient safety.

Today, reducing medication errors and improving patient safety have become common topics of health services around the world.[5] Many developed countries have initiated the research into the role played by patient safety culture research. On a global basis, several international organizations promote the establishment of a culture of patient safety: the WHO Patient Safety Programme will launch in 2014 the Third Global Patient Safety Challenge, focusing on medication safety, the National Patient Safety Agency in the UK, the Agency for Healthcare Research and Quality in US, The Australia Commission of Safety and Quality, and The European Foundation for the Advancement of Healthcare Practitioners.[4,6] There are some developing countries that are oblivious to the problems created by medication errors. However, efforts are now being taken in these countries, especially India, China and Philippines, to set up pharmacovigilance system for collection of information on ADEs.[6-8]

As pharmacies continually strive to improve safety and quality, there is a growing recognition

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of the importance of establishing a culture of patient safety. Achieving such a culture requires an understanding of the values, and beliefs about what is important in the organization and what attitudes and behaviors related to patient safety are expected.[9] The assessment of safety culture in pharmacies has recently begun to develop and the consistency of methods and instruments used across pharmacies needs to be further elaborated.[10] Quite often, hospital pharmacies have been included in overall hospital based safety culture assessments.[11-16] There are a few studies of pharmacy survey on patient safety culture by using different scales.[10,17-19] However, most of these studies focused on the evaluation of the psychometric properties of the scales or on developing, and examining the component structure and internal consistency of the survey instruments.[10,18,19] E.g. the study by Ashcroft aims to develop a Pharmacy Safety Climate Questionnaire (PSCQ) and examine the component structure and internal consistency in the community pharmacy setting in England.[19] Nevertheless, no study to date, to our knowledge, using survey developed for pharmacists has been published in which the safety culture in hospital pharmacies has been assessed.

In this study, ~~we measured~~ the patient safety culture in China's hospital pharmacies were measured by using the modified version of Pharmacy Survey on Patient Safety Culture (PSOPSC) developed by AHRQ (version 2012).[9] We also compared some of the findings with existing data from the AHRQ pilot study. Meanwhile, we intended to assess the quality of this investigative questionnaire.

Methods

Questionnaire

The Pharmacy Survey on Patient Safety Culture (PSOPSC) was translated and modified to suit the Chinese system. The original PSOPSC was developed by AHRQ in 2012 on the purpose of pilot study which was designed to assess 11 dimensions of pharmacy with 36 items of patient safety

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culture.[9] The questionnaire also included three questions that ask respondents to rate the frequency with which mistakes were documented and one question that provides an overall rating on patient safety.[20] Additionally, the original PSOPSC contained a section of *"Background Questions"* as well as an open ended section. We made a slight emendation of PSOPSC questionnaire by combining two items—(A3:"*Technicians in this pharmacy receive the training they need to do their jobs"* and A10: " *Staff get enough training from this pharmacy"*) into one item because they were almost the same meaning in Chinese translation. Furthermore, we added two items to the section *"Background Questions"*—(gender and hospital levels) and refreshed the qualification categories to adapt to Chinese context.

The survey used either 5-point agreement scales ("Strongly disagree" to "Strongly agree") or frequency scales ("Never" to "Always"). Items include a "Does not apply or Don't know" option.[20]

The permission to use PSOPSC was obtained from AHRQ. The Chinese translation was carried out in several steps. First, the recommended guideline of PSOPSC: *User's Guide* was carefully discussed within the research group before translation. The first translation was done by a graduate medical student with background in patient safety. Then, the translation was double checked and reviewed by the research group including experts in pharmacy, methodologists, and English. Finally, we pre-rest the translation in the pilot investigation for further improvement before formal investigation. We had a further discussion regarding to some wordings and especially on some items that would cause misunderstanding in Chinese language. (e.g.the items of *"We feel rushed when processing prescriptions"*,*" Staff feel like their mistakes are held against them"*,*"Staff feel comfortable asking questions when they are unsure about something"* and the last section of *"Documenting Mistakes"*).

Sample

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Convenient sampling was used to survey hospital pharmacies (one of the hospial departments) throughout southwest part of China. The self-administered questionnaire was conducted over six months from March through August 2013 with 20 hospital pharmacies included(pharmacy workers ranging from 30 to 60 in each hospital).We involved in all pharmacy staff (including senior and junior pharmacists and pharmacy interns) working in the pharmacy area where prescriptions were dropped off, filled, dispensed, and picked up or prepared for delivery.[9]

To ensure the privacy of the respondents, the survey was strictly anonymous. Permission to conduct the investigation was granted by the hospital pharmacy directors before investigation. The participants were informed of the purpose of the survey and voluntarily completed a paper copy of the questionnaire by the research coordinators in different hospitals.

Data screening and collection

After receiving the completed questionnaires, a preprocessing step was applied to remove incomplete or invalid data and based on the study by Hellings J.[14] We checked and examined the returned questionnaire. The exclusion criteria were similar to two studies: 1) there was no entire section completed; 2) there was fewer than half items answered or all the items answered the same.[4,14] All data was entered by two researchers (Jia PL and Zhang LH) independently, and then were cross-checked mutually by Epidata (version, 3.02). In case of doubts or disagreement in some answers, we looked into the original questionnaires. Negatively worded items were reversed to ensure that positive answers indicated a higher score. Most of the items in the questionnaire used the Likert 5- point response scale of agreement (Strongly disagree to Strongly agree) or frequency (Never to Always), so the lowest three scoring(1-3) answers (Strongly disagree/Disagree/Neither Agree nor Disagree or Never/Rarely/Sometimes), the highest two scoring (4-5) answers(Agree /Strongly agree or Most of the time/Always), as well as the highest two scoring answers were perceived as positive response answers, and the lowest three scoring answers were deemed other response answer. We

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calculated the positive response rate according to the formula by the User's Guide of PSOPSC.[9] Items marked as "Does Not Apply/Don't Know" response option by the respondents were excluded when displaying percentages of response and the positive response scores.[9]

Data analysis

We analyzed the demographic characteristics using the Excel 2007. The number of positive response/positive response rate of all the items was also summarized. Positive response rate was used to evaluate the attitudes towards patient safety culture on different dimensions or items. We used Chi-Square test to compare whether there was a statistical difference on pharmacy staff in hospital and qualification levels towards patient safety culture. A Chi-squared test was also used to infer if there was a statistical difference on *"patient safety grade"* in Chinese pharmacies compared with that of US pharmacies, with the significant level of $P = 0.05$.

We calculated Cronbach's a and exploration factor analysis to evaluate the quality of the questionnaire. Internal consistency value (Gronbach's $\alpha \geq 0.70$) for newly developed scales was recommended.[4] Structure validity was explored using principal component factor analysis by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO> 0.7) and by Bartlett's Test of Sphericity $P < 0.05$.

Intercorrelations among 11 dimensions were calculated using the non-parametric Spearman test as it is adapted to qualitative ordinal variables. The correlations should be less than 0.8 for the composites to be considered unique and avoid problems with multicollinearity.[12]

A test–retest was administered in a specialized hospital to assess the reproducibility. Thirty-three randomly selected pharmacy staff were asked to answer the questionnaire twice with a 2-week interval between the test and the retest. Test–retest reliability was assessed by the one-way intra-classcorrelation coefficient (ICC type (1, 1).[21] Reliability was considered good if ICC was greater than 0.70.[21]

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Ethic

This was a non-interventional survey.We were informed that no required from the ethics committee needed this time by the hospital ethics committee. However, responding to the questionnaire was voluntary and all answers were de-identified to maintain confidentiality.

Results

Sample and response statistics

A total of 630 questionnaires were distributed of which 527 were responded validly (84%). Three hundred and seventy nine (72%) of the respondents were female, 421 (80%) were junior pharmacists, followed by pharmacy interns (16%) and senior pharmacists (4%). The majority of the respondents (68%) was from Third-grade hospitals (Table 1).

Table 1 Demographic characteristics of respondents

Characteristics	Senior pharmacist (n = 20)	Junior pharmacist (n = 421)	Pharmacy intern (n = 86)	Total (n = 527)
Sex				
Male	4(2.7)	115(77.7)	29(19.6)	148(100[a])
Female	16(4.2)	306(80.8)	57(15.0)	379(100)
Working time in hospital				
Less than 6 months	3(5.6)	40(74.1)	11(20.4)	54(100)
6 months to less than 1 year	5(6.4)	57(73.1)	16(20.5)	78(100)
1 to 3 years	5(4.0)	104(83.9)	15(12.1)	124(100)
3 to 6 years	3(3.0)	82(81.2)	16(15.8)	101(100)
6 to 12 years	1(1.4)	55(77.5)	15(21.5)	71(100)
12 years or more	3(3.0)	83(83.8)	13(13.1)	99(100)
Working hours per week				
1 to 16 hours	0(0)	14(87.5)	2(12.5)	16(100)
17 to 31 hours	1(4.5)	18(81.8)	3(13.6)	22(100)
32 to 40 hours	14(4.7)	244(73.2)	42(14.0)	300(100)
More than 40 hours	5(2.6)	145 (76.8)	39(20.6)	189(100)
Hospital level [b]				
Third-grade hospital	14(3.9)	290(81.2)	53(14.8)	357(100)
Second-grade hospital	6(3.5)	131(77.1)	33(19.4)	170(100)

[a] Parenthesis represent percentage

[b] Third-grade hospital: provincial and municipal hospital

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Second-grade hospital: reginal hospital

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In our study, the percentage of positive responses for the 11 patient safety culture dimensions ranged from 50% to 88%, the mean positive response rate was 71%. The lowest positive response rate of dimension was *"Staffing, Work Pressure, and Pace"* (50%), while the highest positive response rate of dimension was "*Staff Training and Skills"* (88%). There were two dimensions of which positive response rate were less than 60% such as "*Patient Counseling"*(57%), and "*Staffing,Work Pressure, and Pace"* (50%). The positive response rate for the rest of the items ranged from 37% to 90%. The highest positive response rate of the three items reached 90% , while the lowest positive response rate of the item was "*Staff feel like their mistakes are held against them"*(37%)(Table 2).

However, the 2012 Preliminary Comparative Results: PSOPSC in US showed that the average positive response rate of 11 dimensions ranged from 41% to 90%, the overall average positive response rate for dimensions was 78%. The lowest positive response rate of item was "*We feel rushed when processing prescriptions"*(14%) and the highest positive response rate item was"*Our pharmacists tell patients important information about their new prescriptions"* (93%).There were 4 items of which the positive response rate were less than 60% (Table 2).

There were some differences between the adapted Chinese PSOPSC with that of original US PSOPSC, so only the same items were compared to explore the differences of perceptions towards patient safety culture between the two countries. The results showed that there was a significant difference on three items ($P < 0.05$) of which the positive response rate on three items in China was higher than that of the US. These dimensions were (1) *Teamwork, (2) Staffing, Work Pressure, and Pace.* However, there was a significant difference on 18 items ($P < 0.05$), which of the positive response rate on 18 items in China was lower than that of the US (Table 2).

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Table2 Positive response rate of each item , Cronbach's α for dimensions and reproducibility

Dimension/items(internal consistency reliability coefficient)	US	China	ICC
1 Physical Space and Environment (Cronbach's α=0.60)	72%	69%	
A1. This pharmacy is well organized.	84%	84%	0.86
A5. This pharmacy is free of clutter	67%	53%	0.80
A7. The physical layout of this pharmacy supports good workflow.	65%	69%	0.69
2. Teamwork (Cronbach's α=0.44)	81%	84%	
A2. Staff treat each other with respect.	79%	86%	0.74
A4. Staff in this pharmacy clearly understand their roles and responsibilities.	81%	90%	0.86
A9. Staff work together as an effective team.	82%	77%	0.80
3. Staff Training and Skills(Cronbach's α=0.75)	79%	88%	
A3. Technicians in this pharmacy receive the training they need to do their jobs	81%	87%	0.78
A6. Staff in this pharmacy have the skills they need to do their jobs well.	86%	90%	0.86
A8. Staff who are new to this pharmacy receive adequate orientation	72%	88%	0.86
4. Communication Openness(Cronbach's α=0.57)	87%	64%	
B1. Staff ideas and suggestions are valued in this pharmacy	81%	64%	0.30
B5. Staff feel comfortable asking questions when they are unsure about something	91%	72%	0.88
B10. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns	88%	57%	0.52
5. Patient Counseling(Cronbach's α=0.69)	90%	57%	
B2. We encourage patients to talk to pharmacists about their medications.	92%	56%	0.80
B7. Our pharmacists spend enough time talking to patients about how to use their medications	86%	52%	0.94
B11. Our pharmacists tell patients important information about their new prescriptions	93%	63%	0.73
6. Staffing, Work Pressure, and Pace(Cronbach's α=0.50)	41%	50%	
B3. Staff take adequate breaks during their shifts	56%	60%	0.92
B9. We feel rushed when processing prescriptions. (negatively worded)	14%	40%	0.81
B12. We have enough staff to handle the workload.	56%	62%	0.92
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)	40%	37%	0.72
7. Communication About Prescriptions Across Shifts(Cronbach's α=0.84)	81%	79%	
B4. We have clear expectations about exchanging important prescription information across shifts	84%	83%	0.79
B6. We have standard procedures for communicating prescription information across shifts.	78%	77%	0.72
B14. The status of problematic prescriptions is well communicated across shifts	81%	77%	0.76
8. Communication About Mistakes(Cronbach's α=0.17)	79%	62%	
B8. Staff in this pharmacy discuss mistakes.	74%	50%	0.93
B13. When patient safety issues occur in this pharmacy, staff discuss them.	84%	57%	0.73
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.	81%	78%	0.68
9. Response to Mistakes (Cronbach's α=0.57)	79%	65%	
C1. Staff are treated fairly when they make mistakes	80%	81%	0.71
C4. This pharmacy helps staff learn from their mistakes rather than punishing them	84%	66%	0.84
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.	84%	76%	0.86
C8. Staff feel like their mistakes are held against them. (negatively worded)	69%	37%	0.66
10. Organizational Learning—Continuous Improvement(Cronbach's α=0.48)	83%	84%	
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.	90%	90%	0.74
C5. When the same mistake keeps happening, we change the way we do things	82%	81%	0.71
C10. Mistakes have led to positive changes in this pharmacy	79%	82%	0.76
11. Overall Perceptions of Patient Safety (Cronbach's α=0.45)	84%	80%	
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)	80%	79%	0.73
C6. This pharmacy is good at preventing mistakes.	85%	76%	0.94
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.	86%	84%	0.68

ICC, intra-class correlation coefficient

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Comparative results

The results showed that there was a significant difference on seven dimensions between Third-grade hospital and Second-grade hospital ($P < 0.05$). The positive response rate of five items of Third-grade hospitals was lower than that of Second-grade hospitals: (1) *This pharmacy is free of clutter* (2) *Our pharmacists spend enough time talking to patients about how to use their medications* (3) *Staff take adequate breaks during their shifts* (4)*We feel rushed when processing prescription* (5) *Interruptions/distractions in this pharmacy make it difficult for staff to work accurately"* ($P < 0.05$). The positive response rate of other items of Third-grade hospitals was higher than that of Second-grade hospitals (Table 3).

Incidence of patient safety events was closely related to the qualification levels of pharmacists. Our results showed that there was a significant difference in the positive response rate on two dimensions("*Staffing, Work Pressure, and Pace"*and "*Communication About Prescriptions Across Shifts",* $P<0.05$) for senior pharmacists, junior pharmacists and pharmacy intern. Furthermore, the positive response rate of pharmacists with high qualification(senior pharmacists) was higher than those with low qualification level (junior pharmacists) on the two items: "*Staff take adequate breaks during their shifts"*and "*We have standard procedures for communicating prescription information across shifts"* $P<0.05$ (Table 3).

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able 3 The comparison of attitudes of different levels of hospitals and qualification of hospital pharmacists on patient safety culture

Items	Hospital Levels						Qualification Levels				
	Third-grade Hospital		Second-grade Hospital		χ^2	*p*	Senior Pharmacist		Junior Pharmacist		Pharm Inte
	NPR	NOR	NPR	NOR			NPR	NOR	NPR	NOR	NPR
organized.	316	41	123	47	21.63	0.000	18	2	355	66	66
of clutter	171	186	107	63	10.45	0.001	12	8	223	198	43
this pharmacy supports good workflow.	236	121	123	47	2.07	0.15	16	4	288	133	55
with respect.	308	49	141	29	1,01	0.31	18	2	360	61	71
clearly understand their roles and responsibilities.	321	36	150	27	0.34	0.56	19	1	312	49	80
an effective team.	283	74	116	54	7,63	0.006	16	4	321	100	62
armacy receive the training they need to do their jobs	308	49	139	31	1.82	0.18	14	6	353	68	73
have the skills they need to do their jobs well.	319	38	150	27	0.15	0.70	19	1	376	45	74
his pharmacy receive adequate orientation	309	48	144	26	0.33	0.57	17	3	360	61	76
tion are valued in this pharmacy	220	137	101	69	0.24	0.63	16	4	253	168	52
asking questions when they are unsure about something	255	102	110	60	2.45	0.12	17	3	289	132	59
speak up to their supervisor/ manager about patient safety concerns in this pharmacy.	193	164	92	78	0.000	0.99	9	11	232	189	44
to talk to pharmacists about their medications.	192	165	87	83	0.31	0.58	14	6	217	204	48
enough time talking to patients about how to use their medications	274	83	137	33	0.99	0.32	13	7	231	208	46
patients important information about their new prescriptions	214	143	94	76	1.03	0.31	12	8	247	174	49
eaks during their shifts	187	170	121	49	16.75	0.000	18	2	245	176	45
processing prescriptions. (negatively worded)	110	247	87	83	20.40	0.000	8	12	153	268	36
f to handle the workload.	212	145	202	68	0.02	0.89	15	5	251	170	48
ons in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for ly. (negatively worded)	116	241	71	99	4.32	0.04	6	14	147	274	34
tion about exchanging important prescription information across shifts	171	186	101	69	6.11	0.01	17	3	333	88	61
ced ures for communicating prescription information across shifts.	241	116	126	44	2.28	0.12	16	4	303	118	48
nation prescriptions is well communicated across shifts	257	100	126	44	0.26	0.61	18	2	307	114	58
discuss mistakes.	180	177	72	98	3.00	0.08	11	9	201	220	40
ssues occur in this pharmacy, staff discuss them.	208	149	84	86	3.65	0.06	11	9	233	188	48
talk about ways to prevent mistakes from happening again.	283	74	116	54	7.63	0.006	16	4	319	102	64
when they make mistakes	287	70	131	39	0.78	0.38	17	3	330	91	71
staff learn from their mistakes rather than punishing them	222	135	120	50	3.57	0.06	15	5	275	146	52
s and the way we do things to understand why mistakes happen in this pharmacy.	268	89	117	53	2.28	0.13	15	5	313	108	57
stakes are held against them. (negatively worded)	118	239	68	102	2.43	0.12	5	15	152	269	29
ns, we try to figure out what problems in the work process led to the mistake.	323	34	145	25	3.11	0.08	19	1	371	50	78
e knows happening, we change the way we do things	291	66	127	43	3.25	0.07	18	2	335	86	65
positive changes in this pharmacy	298	59	118	52	13.70	0.000	16	4	337	84	63
more emphasis on sales than on patient safety. (negatively worded)	274	83	132	38	0.05	0.82	17	3	323	98	66
at preventing mistakes.	276	81	116	54	4.98	0.03	17	3	315	106	60
in this pharmacy reflects a strong focus on patient safety.	306	51	129	41	7.73	0.005	19	1	351	70	65
es the patient and could cause harm but does not,how often is it documented?	200	157	99	71	0.23	0.63	12	8	243	178	44
es the patient but has no potential to harm the patient, how often is it documented?	207	150	95	75	0.21	0.65	13	7	246	175	43
ould have harmed the patient is corrected before he medication, leaves pharmacy, ented?	209	148	95	75	0.33	0.56	14	6	244	177	41

ber of positive response answers; NOR,Number of other response

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Patient safety grade in China and the US and different qualification levels

The percentage of staff who rated the level of patient safety as "*good"*, "*very good*"or "*Excellent*" was 79% in our study, which was lower than the US score of 95%, there was a significant difference between the two groups (P<0.001). While there was no significant difference on "*Patient safety grade"* in different qualification levels (P=0.66) (Table 4).

Table 4 The comparisons of patient safety grade between different position of hospital pharmacists

Patient safety grade	Senior Pharmacist (%)	Junior Pharmacist (%)	Pharmacy Intern(%)	China(%)	US(%)
Excellent	2[a](6.5)	25(80.6)	4(12.9)	84(16)	191(40)
Very good	1(1.2)	69(85.2)	11(13.6)	227(43)	211(44)
Good	6(5.6)	80(74.8)	21(19.6)	105(20)	53(11)
Fair	7(3.1)	184(81.4)	35(15.5)	79(15)	24(5)
Poor	4(4.9)	63(76.8)	15(18.30	32(6)	0

[a] number of the respondents

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Reliablity and validity

In our research, the Cronbach's alpha was of 0.89 for the questionnaire and ranged from 0.17 to 0.83 for dimensions. The dimension"*Communication About Mistakes"* had the lowest coefficients of 0.17 (Table 2). Yet in the US, the Cronbach's α was ranged from 0.68 to 0.89 for dimensions of which "*Staffing, Work Pressure, and Pace"* had the lowest values of 0.68.

Bartlett's test of the 35 items on patient safety culture demonstrated a sufficient inter-item correlation: $\chi^2 = 12037.98$, df = 595, $P < 0.01$. Furthermore, the Kaiser –Meyer-Olkin measure of sampling adequacy was satisfactory, with a value of 0.935. Explorative factor analysis was performed using principal component analysis with varimax rotation drawing seven factors. The factors cumulatively explained 59 % of the variance in the survey and the result was acceptable.

Thirty-three participants answered twice to the questionnaire. For the 35 items, an ICC ranged from 0.30 to 0.94. Twenty-nine items had an ICC above 0.70, five items had an ICC between 0.50 and 0.70 and one item had an ICC under 0.50 (Table 2).

The inter-correlations of the 11 dimensions, and correlations between the scale scores were also calculated. No dimension had high correlations above 0.80, with other dimensions. "*Communication Openness"* and "*Patient Counseling"* (r = 0.74) was most correlated, while "*Staffing, Work Pressure, and Pace"* and *"Overall Perceptions of Patient Safety "*(r = 0.01) was least correlated. The highest intercorrelations was 0.78 between *"Communication Openness" a*nd the scale (r = 0.78). The correlation between each dimension and the total scale were significantly different (Table 5).

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Table 5 Correlation with the total scale and inter-correlations of the 11 dimensions

Dimensions	1	2	3	4	5	6	7	8	9	10	11	Total
1 Physical Space and Environment	1.00	0.15	0.12	0.27	0.25	0.22	0.26	0.22	0.73	0.61	0.15	0.14*
2. Teamwork		1.00	0.12	0.44	0.30	0.28	0.31	0.28	0.64	0.55	0.15	0.14*
3. Staff Training and Skills			1.00	0.39	0.34	0.33	0.44	0.33	0.56	0.44	0.09	0.16*
4. Communication Openness				1.00	0.74	0.63	0.37	0.57	0.37	0.36	0.03	0.78*
5. Patient Counseling					1.00	0.70	0.70	0.70	0.20	0.02	0.05	0.76*
6. Staffing, Work Pressure, and Pace						1.00	0.68	0.69	0.02	-0.05	0.01	0.77*
7. Communication About Prescriptions Across Shifts							1.00	0.68	0.20	0.05	0.07	0.75*
8. Communication About Mistakes								1.00	0.20	-0.05	0.10	0.77*
9. Response to Mistakes									1.00	0.32	0.04	0.17*
10. Organizational Learning—Continuous Improvement										1.00	0.12	0.18*
11. Overall Perceptions of Patient Safety											1.00	0.13*

*All correlations are significant at P < 0.001

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Finally, table 6 presented the factor loadings for each item (all loadings > 0.30). Factor one loadings on five dimensions, and factor two loading on three dimensions *("Physical Space and Environment", "Teamwork"* and "*Staff Training and Skills"),* and factor three on "*Overall Perceptions of Patient Safety".*

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Table 6 Factors loading in each item

Items	*1*	*2*	*3*	*4*	*5*	*6*	*7*
A1. This pharmacy is well organized.		0.78					
A5. This pharmacy is free of clutter		0.55					
A7. The physical layout of this pharmacy supports good workflow.		0.72					
A2. Staff treat each other with respect.		0.82					
A4. Staff in this pharmacy clearly understand their roles and responsibilities.		0.47					0.30
A9. Staff work together as an effective team.		0.80					
A10. Technicians in this pharmacy receive the training they need to do their jobs		0.41					
A11. Staff in this pharmacy have the skills they need to do their jobs well.		0.41					
A12. Staff who are new to this pharmacy receive adequate orientation		0.66					
B1. Staff ideas and suggestions are valued in this pharmacy	0.73						
B4. Staff feel comfortable asking questions when they are unsure about something	0.97						
B10. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns in this pharmacy.	0.95						
B2. We encourage patients to talk to pharmacists about their medications.	0.96						
B7. Our pharmacists spend enough time talking to patients about how to use their medications	0.96						
B11. Our pharmacists tell patients important information about their new prescriptions	0.61						
B3. Staff take adequate breaks during their shifts	0.73						
B9. We feel rushed when processing prescriptions. (negatively worded)	0.92						
B12. We have enough staff to handle the workload.	0.61						
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)	0.94						
B1. We have clear expectations about exchanging important prescription information across shifts	0.73						
B6. We have standard procedures for communicating prescription information across shifts.	0.72						
B14. The status of problematic prescriptions is well communicated across shifts	0.96						
B8. Staff in this pharmacy discuss mistakes.	0.74						
B13. When patient safety issues occur in this pharmacy, staff discuss them.	0.60						
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.	0.53						
C1. Staff are treated fairly when they make mistakes				0.92			
C4. This pharmacy helps staff learn from their mistakes rather than punishing them			0.65				
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.			0.68				
C8. Staff feel like their mistakes are held against them. (negatively worded)			0.41		0.54		
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.					-0.75		
C5. When the same mistake keeps happening, we change the way we do things			0.69				
C10. Mistakes have led to positive changes in this pharmacy				0.91			
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)			-0.71				
C6. This pharmacy is good at preventing mistakes.		0.39	0.71				
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.			0.43			0.33	-0.35

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Discussion

The study is the first publication of its kind using the PSOPSC to explore patient culture in hospital pharmacy sector. It is, furthermore, the first Chinese study to report data on perspectives of patient culture in different levels of qualification and hospital in pharmacy setting. The PSOPSC has been introduced by AHRQ for about one year which was only conducted for pilot study in US pharmacies.[20] We adopted this survey in our research, because we take the consideration that this is a very comprehensive patient safety culture survey focused on the pharmacy sector which is best suitable for examining patient safety climate from a hospital pharmacy perspective. Moreover, the survey will enable the pharmacies to assess areas of strength and identify areas for improvement in their patient safety culture as part of their quality improvement activities.

In our study, the response rate was 84% which was higher than the pilot study implemented in US (75%).[20] A high response rate on a questionnaire about safety attitudes might be a measure of the staff 's attentiveness to these issues.[22] Overall, the mean positive response rate for the 11 patient safety culture dimensions of the PSOPSC survey was 71%, slightly higher than the other two studies conducted in Taiwan by Chen 2012[23]and the mainland of China by Nie 2013.[4] Comparing with these two studies, we found that the three studies have a common feature that they predominantly used surveys to assess individual attitudes covering areas related to work environment, adherence to guidelines and safety concerns.[24] The only difference is that Chen and Nie used the Hospital Survey on Patient Safety Culture (HSPSC) for all health care workers within organizational level ,while we

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used PSOPSC for hospital pharmacy workers which thereby, elicits a snapshot of the safety climate in the specific setting. Meanwhile, in some other studies, the pharmacists surveyed were relatively in a small size in their study populations, such as the HSPSC study in Japan by Shinya Ito, 155(2.4%) pharmacists were included,[11] and the HSPSC study in US by Joann S Sorra, 1215(2%) pharmacists were included.[12]

Our study found that there was substantial variability in the percent of positive scores across 11 dimensions. The dimension "*Staff Training and Skill"*appeared to receive the highest positive response rate (88%). An explanation for this might be the fact that the national job training project for pharmacists in China named *'Clinical Pharmacist pilot Training'* for a long time put great effort into providing clinical pharmacy training for pharmacists who are working or will work as clinical pharmacists from different hospitals.[25] But another possible reason is that the relatively high proportion of positive responses might be that the translation was inadequate, and that a ceiling effect occurred.[10] Simultaneously, the dimension "*Teamwork"* received a positive response rate of 84% in our study,which is similar to the studies reported by Belgium,[14] Turkey,[26] Swedish,[10] US,[27], China[4] and Taiwan[23] (70%,76%,78%,80%,84%,and 94% ,respectively). The interpretation of the results within a given setting is that if ⩾ 80% of the respondents report positive assessments on a specific item or set of items, then there is a strong positive consensus in that setting.[10] A score of less than 60% is considered to be in the "needs improvement," range.[10] Hence, ⩾60% is a threshold for which safety climate can be considered acceptable. ~~Hooly, we can conclude that the~~

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~~respondents were delight in cooperating with others and well functioning relative to hospital departments.~~

This study displayed that both in China and US, the dimensions that received the lowest positive rate was *"Staffing, Work Pressure, and Pace"*(50% and 41%, respectively),indicating that the respondents feel that staff allocation is not adequate to handle patient safety related workload.[4] Our results are according with those reported by Hellings and the study conducted in Taiwan and China. [4,14,23,28] Meanwhile, a study by Elisa E in Northern California hospital of US showed that the most common causes of medication errors were high workload (25.3%), fatigue or lack of sleep (16.5%).[29] Therefore it is important for pharmacy to allocate staffs and working hours more adequately to reduce the medication errors and improve patient safety. In addition, in our study, another relatively low positive response rate was the dimension *"Patient Counseling"* (57%) which reflected the problem in China: poor healthcare worker (including pharmacy staff)~~doctor~~-patient communication. A study by Zou in China indicated that 49% medical lawsuits related to poor healthcare worker~~doctor~~-patient communication.[30] A study by Moore P showed that of 635 complaints involved a doctor, 49 cases (15%) were because of "Lack of communication".[31] Lack of 'communication openness' was identified as a major safety culture problem. In other words, communication openness was seriously jeopardised by the lack of trust between health workers and patients in China reported by Liu in the recent study.[32]

The results showed that the positive response numbers of Third-grade hospital regarding

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patient safety culture was higher than that of Second-grade hospital. The reason account for this may be that in China, the Third-grade hospital always manage severe clinical cases so the pharmacies of Third-grade hospital have a higher potential for life-threatening medical errors. As most risky medical interventions take place in these hospitals, the staff have to get better training to deal with in safety-related issues.[26] Simultaneously, our study found that the positive response rate of pharmacists with high qualification (senior pharmacists) was higher than those with low qualification level (junior pharmacists) on the dimension *"Staffing, Work Pressure, and Pace"*. Seniority has been found to bring about experience,[22] as they know the pitfalls of the pharmacy work and can avoid them masterly which might reduce the risk for error making, so senior pharmacists might work more effectively and had a positive attitude to their work pressure. This was also elucidated in the study by Sorlie V that the more experience physicians gained, the more confident they would feel.[33] So we can infer that the experiential proficiency is a prerequisite to this higher positive response.

The pharmacy is an important link between the patient and medication, so developing a culture of safety has become one of the pillars of the pharmacy. According to the report of China Food and Drug Administration(CFDA), a total of 852,799 drug adverse events happened in China in 2011.[7] Chinese Hospital Association (CHA) estimated that adverse events affect 1.6 ~ 7.6 million hospitalizations annually in Chinese hospitals.[34] A study by Li,XL showed that 1165 medication errors reported by 22 hospitals in Beijing in 2012[35]and another study by Li,XY in China indicating that 32 (26.30%) dispensing errors were applied to the pharmacists and 5 (4.03%) dispensing errors

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were related to the environment of the pharmacy.[36] The adaptation of this instrument to the Chinese pharmacy context not only is an important milestone for safety research in pharmacies but also provides the pharmacies with an instrument that generates diagnostic and actionable information for pharmacies and leaders to use in guiding improvement efforts.[37] The findings of the study illustrated that the pharmacies and health care organizations in China should have imperatives to develop strategies to improve pharmacy service quality and ensure patient safety. These strategies include: strengthen patient safety training for pharmacy staffs, reasonable allocate staff and workload, creating an environment conducive to reporting errors by focusing on the process or system failure instead of the individual who committed the error.[38] What's more, we should raise awareness of the important of patient engagement in improving medication safety because a global concerted effort is need to address medication safety and it needs the involvement of all health-care stakeholders, including patient. In addition, building trust between providers and patients and between managers and health workers is essential for empowering health workers to address patient safety issues.[32]

Reliability and validity

Using the explorative factor analysis drew 7 factors. The factors cumulatively explained 59 % of the variance in the survey and the result was acceptable. Using Cronbach's a, all subscales had acceptable levels of reliability, which varied from 0.84 for "*Communication About Prescriptions Across Shifts"* to 0.44 for "*Teamwork",* with the exception of the dimension "*Communication about Mistakes*" which had the lowest value 0.17. The results were less satisfactory as compared to AHRQ data.[20] The

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dimension "*Communication about Mistakes*" received the lowest Cronbach's a among the 11 dimensions, three reasons could account for this.Firstly, a possible explanation was the translation, scale should not be translated and applied in another setting of a different cultural context directly.[4] Secondly, factor structure of the PSOPSC model for these items might not fit the data well.[23] Thirdly, the sample size of the data might not be large enough to achieve consistency.[23] But, the low reliability also suggested the instability of the aspects measured by the questionnaire, which are based on professionals' perceptions of safety (themselves linked to safety circumstances at a given time, and inherently instable and subject to change). If culture does not change so rapidly, perceptions do.[21] Finally, unlike other similar studies published anywhere focused on tool evaluation or developing the survey tool, the primary objective of our study focused on "to explore the attitudes and perceptions of patient safety culture for pharmacy workers in China by using a Pharmacy Survey on Patient Safety Culture ", Hence, we did not conduct a confirmatory factor analysis to test hypotheses about a particular factor structure which might be a weakpoint in this study. However, we will take this into our consideration with larger sample size in our future study

Conclsion

The results demonstrated that among the pharmacy staff surveyed in China there was a positive attitudes towards patient safety culture in their organizations. The Chinese translation of PSOPSC questionnaire (version 2012) used in our study was acceptable.

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Footnotes

Acknowledgement

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Contributors

MMZ conceptualized and designed the study. PLJ and LHZ performed and interpreted the data analysis. MMZ and PLJ drafted and revised the manuscript critically for intellectual content. The rest of authors did data collection and checked data input. All authors read and approved the final manuscript.

Competing interests

None

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Data sharing statement

No additional data are available.

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Supplemental file

Table 1 the modified Chinese English version

The questionnaire of the modified Chinese English version
Dimension/items
1 Physical Space and Environment
A1. This pharmacy is well organized.
A5. This pharmacy is free of clutter
A7. The physical layout of this pharmacy supports good workflow.
2. Teamwork
A2. Staff treat each other with respect.
A4. Staff in this pharmacy clearly understand their roles and responsibilities.
A9. Staff work together as an effective team.
3. Staff Training and Skills
A3. Technicians in this pharmacy receive the training they need to do their jobs
A6. Staff in this pharmacy have the skills they need to do their jobs well.
A8. Staff who are new to this pharmacy receive adequate orientation
4. Communication Openness
B1. Staff ideas and suggestions are valued in this pharmacy
B5. Staff feel comfortable asking questions when they are unsure about something
B10. It is easy for staff to speak up to their supervisor/ manager about patient safety concerns in this
5. Patient Counseling
B2. We encourage patients to talk to pharmacists about their medications.
B7. Our pharmacists spend enough time talking to patients about how to use their medications
B11. Our pharmacists tell patients important information about their new prescriptions
6. Staffing, Work Pressure, and Pace
B3. Staff take adequate breaks during their shifts
B9. We feel rushed when processing prescriptions. (negatively worded)
B12. We have enough staff to handle the workload.
B16. Interruptions/distractions in this pharmacy (from phone calls, faxes, customers, etc.) make it difficult for staff to work accurately. (negatively worded)
7. Communication About Prescriptions Across Shifts
B4. We have clear expectations about exchanging important prescription information across shifts
B6. We have standard procedures for communicating prescription information across shifts.
B14. The status of problematic prescriptions is well communicated across shifts
8. Communication About Mistakes
B8. Staff in this pharmacy discuss mistakes.
B13. When patient safety issues occur in this pharmacy, staff discuss them.
B15. In this pharmacy, we talk about ways to prevent mistakes from happening again.
9. Response to Mistakes
C1. Staff are treated fairly when they make mistakes
C4. This pharmacy helps staff learn from their mistakes rather than punishing them
C7. We look at staff actions and the way we do things to understand why mistakes happen in this pharmacy.
C8. Staff feel like their mistakes are held against them. (negatively worded)
10. Organizational Learning—Continuous Improvement
C2. When a mistake happens, we try to figure out what problems in the work process led to the mistake.
C5. When the same mistake keeps happening, we change the way we do things
C10. Mistakes have led to positive changes in this pharmacy
11. Overall Perceptions of Patient Safety
C3. This pharmacy places more emphasis on sales than on patient safety. (negatively worded)
C6. This pharmacy is good at preventing mistakes.
C9. The way we do things in this pharmacy reflects a strong focus on patient safety.
Documenting Mistakes
D1. When a mistake reaches the patient and could cause harm but does not,
D2. When a mistake reaches the patient but has no potential to harm the patient,
D3. When a mistake that could have harmed the patient is corrected before
Overall Rating
E1.How do you rate this pharmacy on patient safety?
Backgroud questioms
F1.How long have you worked in this pharmacy?
F2.Typically, how many hours per week do you work in this pharmacy?
F3.What is your position in this pharmacy? Check ONE category that best applies to your job.
F4.Your gender
F5.Your hospital level
Your Comments
G1. Please feel free to write any comments about how things are done or could be done in your pharmacy

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