Barriers and Facilitators of Compliance with Universal Precautions at First Level Health Facilities in Northern Rural Pakistan

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Abstract

Aim: We assessed the compliance at first level care facilities (FLCF) with universal precautions (UP) and its behavioral predictors using Health Belief Model (HBM).

Methods: A sample of FLCF from public clinic (PC), privately owned licensed practitioners' clinic (LPC) and non-licensed practitioners' clinic (NLPC) was obtained. Health Care Workers (HCW) who diagnose and prescribe medication was termed as Prescriber and that carries out prescriber's order was defined Assistant. Compliance to UP was measured on 11 items Likert scale. HCW responded "always" or "often" to all items of UP were added to compute a binary variable of overall compliance. We used linear regression to assess association between HBM and UP score.

Results: We interviewed 485 HCW (75% prescribers) from 365 clinics; mean age 38±10.4 years. Overall, compliance to UP was 6.6%; 11.6% LPC, 5.3% PC, and 4.4% NLPC. Prescribers were less compliant than Assistants. Compliance with not recapping contaminated needle was poor (PC=32%, LPC=33%, NLPC=15%). Compliance with wearing gloves during blood or body fluid exposure was lowest (30%) at PC. Modes of transmission knowledge, self-efficacy and perceived benefits of safe practice, and susceptibility to blood borne infections were positively associated with UP score.

Conclusion: Higher perception of barriers and severity of blood borne infection result in lower compliance.

Keywords: Universal Precautions, Health Care workers, HBM, blood borne pathogens

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Introduction

Universal Precautions (UP) are defined as "precautions designed for preventing the transmission of blood-borne diseases such as human immunodeficiency virus (HIV), Hepatitis B virus (HBV), and other blood borne pathogens (BBP) when first-aid or health care is provided". [1] The UP include specific recommendations for hand washing, appropriate waste management, use of gloves, gowns, masks, and protective eyewear when contact with blood or body secretions containing blood is anticipated. [1] According to the Centers for Disease Control and Prevention (CDC) guidelines, UP should be consistently used for all patients regardless of their blood-borne infection status. [2]

UP have been shown to reduce risk of blood or body fluid exposure (mucocutaneous/percutaneous exposure) among health care workers (HCW) however, lack of compliance has been commonly reported from both hospitals and first level care facilities (FLCF) globally. [3-6] Studies have shown that lack of knowledge about modes of transmission of BBP, work experience, [3, 4] barriers to safe practice, [4] heavy workload, uncomfortable personal protective equipment (PPE), inaccurate risk assessment, and belief that compliance to UP is unnecessary [7, 8] were associated with non-compliance to UP.

The Health Belief Model (HBM) is a model that attempts to explain and predict health behaviors by focusing on the attitudes and beliefs of individuals. It consists of six constructs which influence adoption of a healthy action by an individual: (i) Perceived susceptibility to an illness; (ii) Perceived severity (seriousness) of the condition; (iii) Perceived benefits of an action; iv) Perceived barriers to action; (v) A stimulus or cue to action and (vi) Perceived self-efficacy in carrying out the required action (figure 1). [7] Studies have identified significant correlation between the major constructs of HBM and preventive health behaviors. [8-10] Also it has been identified that interventions based on the precepts of HBM are more successful than traditional methods. [8, 11]

To the best of our knowledge; limited number of studies about compliance of UP have utilized HBM or other behavioral theories to understand the non-compliance with UP. None of the existing studies have utilized all the constructs of HBM and its association with UP. [3, 13, 14] Also data is scarce regarding compliance with UP among HCW from FLCF. In current study we have collected information on six constructs of HBM and all the components (total 11) of UP to assess the non-compliant behavior of HCW at FLCF. Thus, this study based on theoretical model, assessing the beliefs and behaviors of HCW about UP provide a rigorous framework to develop interventions for improving compliance with UP at FLCF.

Fig 1. *Conceptual model based on Health belief Model*
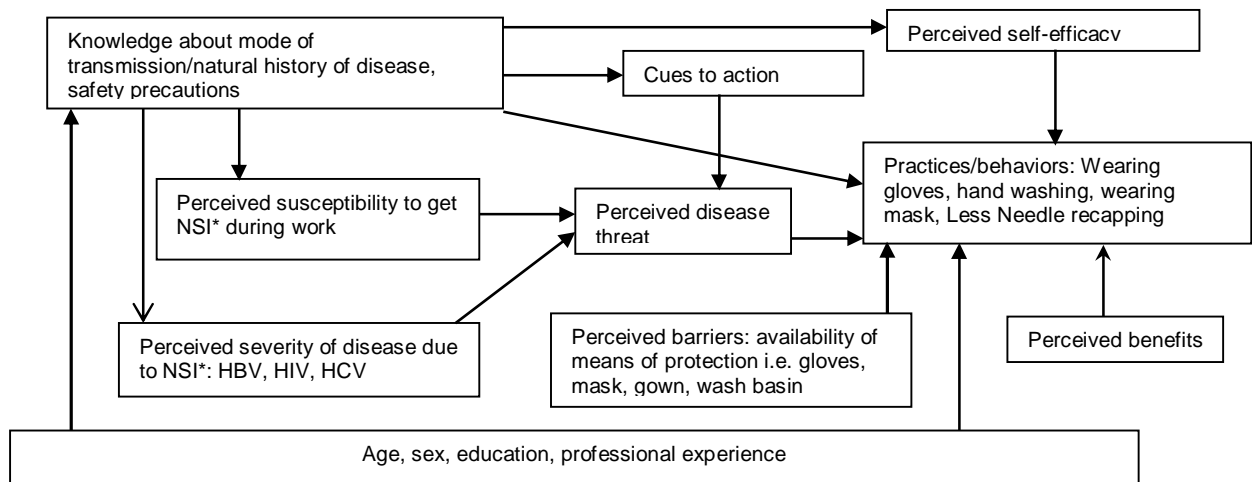
*Source: Janjua NZ, Razaq M, Chandir S, et al. Poor knowledge – predictor of non-adherence to universal precautions for blood borne pathogens at first level care facilities in Pakistan. BMC Infect Dis 2007;7. doi: 10.1186/1471-2334-7-81. [with reprint permission] *NSI=Needle Stick Injury*

Material & methods

Ethical Review Committee of the Aga Khan University provided the approval for conduct of this study.

Design and Setting

A cross sectional study was carried out during July to October 2008 in rural areas of Swabi, Khyber Pakhton Khwa (KPK), Pakistan. The study was carried out in three types of first level care facilities (FLCF); 1) State owned public clinics (PC), 2) Private clinics of the licensed practitioners (LPC), and 3) Private clinics of the non-licensed practitioners (NLPC). Further details about the setting are provided elsewhere. [15]

Selection of health care facilities and HCW:

We used stratified random sampling proportional to number of facilities in each stratum without replacement to select facilities. At each FLCF, there were two types of health care workers (HCW): a prescriber who performs assessment of the patient, makes diagnosis and prescribes medications; and an assistant who carries out prescriber's order, administers injections, and performs wound dressings. We selected one prescriber and one assistant from each facility. In clinics where there were more than one assistant, one was selected randomly. Based on professional qualification, prescribers were classified as licensed or non-licensed. After a written consent, interviews were conducted separately with prescribers and assistants.

Questionnaire and data collection tool

Our questionnaire included validated scales for each construct of health belief model (HBM), compliance with universal precautions (UP), and knowledge scales for modes of transmission of HBV, HCV and HIV. We also inquired about age, work experience, qualification, type of clinic, and respondent's job title. UP scale included 11 Likert type items on various practices (protection against blood and body fluids all time, gloving, gowning, eye protection, hand washing, needle recapping, using puncture resistant sharp container for sharps, extra care while using scalpels, razors, needles etc,) with responses never=0, seldom=1, sometime=2, mostly=3 and always=4. Higher score represents higher compliance with practicing UPs (score range 0-

44). Knowledge about modes of transmission of HBV, HCV, and HIV were measured through three separate knowledge scales each comprising of seven yes/no response items. One point was assigned to each correct response and sum of scores were calculated to measure level of knowledge regarding transmission of HBV, HCV and HIV (score range 0-21). Barriers to UP were measured through an eleven-item bipolar scale with responses -2 to +2 (strongly disagree=-2, disagree=-1, not sure=0, agree=1, strongly agree=2). Positive responses indicate barriers to UP while negative responses indicate lack of barriers (score range -22, +22). Perceived susceptibility to acquire BBP at workplace was assessed through three items with responses ranging from 0= "none" to 3="high" (score range 0-9). Perceived disease severity of BBP after sustaining sharp injuries (SI) was measured through 4 items with responses "strongly disagree=1, disagree=2, not sure=3, agree=4, strongly agree=5". Higher score means higher perceived severity of disease (score range 4-20). Perceived benefits of applying UP were measured through four items using a five point Likert scale (strongly disagree=1, disagree =2, not sure=3, agree=4, strongly agree=5). Higher score reflects higher perception of benefits (score range 4-20). Perceived self-efficacy in practicing UP in different circumstances was measured through a four item scale with responses 0= "never" to 3= "always". Higher score represented higher perception of self-efficacy (score range 0-12). Details of items in each scale are provided as web appendix elsewhere. [15] The knowledge scales used in our questionnaire were adapted from our previous work with Cronbach's alpha score for internal consistency of 0.75. [12] Scales for compliance with UP, and barriers to safe practice were adapted from a study in India. [13] The reported Cronbach's alpha score for UP scale was 0.66. We developed scales on perceived benefits, perceived susceptibility to BBP, perceived severity of disease, and self-efficacy and tested them for reliability with calculated Cronbach's alpha score of 0.48, 0.94, 0.80, and 0.83, respectively.

We calculated the sample size to estimate the average score of compliance with UP by assuming average compliance with UP among HCW at clinics to be 20 (out of 45) with a

population standard deviation of 8, taking 5% level of significance, 1.5% bound on error of estimation, 90% power and adjusting for 20% non-response. The minimum sample size required for this study was 370 FLCF. We approached all prescribers and assistants (majority (88%) of the NLPC were composed of only prescriber and no assistant at all) working in these 370 FLCF and written consent was sought for participation in the study.

Data analysis

Individual responses for each item were summed up to calculate score for each Likert scale. Cumulative knowledge score was calculated by summing up the total score for HBV, HCV and HIV modes of transmission. Means with standard deviations and range were calculated for all continuous scale variables. HCW who responded "always" or "often" to all the eleven items of the UP scale were added together to compute a binary variable of overall compliance with UP.

Predictors for compliance with UP score were identified through multivariable linear regression modeling. We assessed the association of cumulative knowledge about modes of transmission of BBP, barriers in practicing UP, perceived benefits of practicing UP, susceptibility to BBP at workplace, severity of blood borne infections, self-efficacy in practicing UP, and socio demographic characteristics of HCW with UP score as dependent variable. Independent variables found significant at 25% level of significance or constructs of HBM were evaluated in the multivariable linear regression. Adjusted β (Adj.ß) coefficients with 95% confidence interval (95% CI), adjusted coefficient of determination (R^2) and P value were calculated for final model. The final model was developed based on best subset method.

Results

Data were collected from 365 clinics; 5 clinics (one private licensed practitioner clinic (LPC) and four non licensed practitioner clinics (NLPC)) refused to participate in the study. There were 7.9% (29) public clinics (PC), 15.9% (58) private LPC and 76.2% (278) private NLPC in this data set. From all the three types of clinics, 488 health care workers (HCW) were recruited. Data on the universal precautions (UP) scale were missing for three

CW and therefore excluding these participants leaving 485 subjects for the final analysis.

Participant profile

Of the 485 HCW, 363 (75%) were prescribers and 122 (25%) were assistants. At NLPC, only 39/317 (12%) were assistants. In PC and LPC, 29/56 (52%) and 54/112 (48%) were assistants, respectively. Among all HCW, 85/485(18%) were licensed prescribers with graduation from medical or dental school, 278 (57%) non licensed prescribers, 79 (16%), qualified assistants, and 43(9%) un-qualified assistants (Fig 2). Mean age of HCW in all the
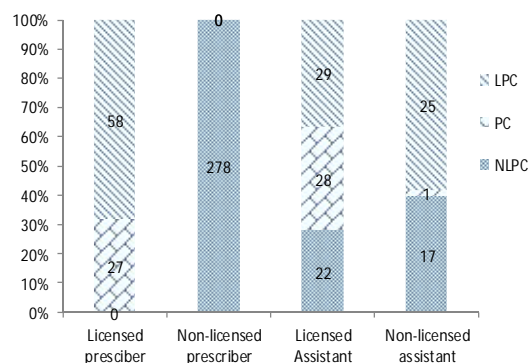
three types of clinics was 38±10.3 years; PC: 41±9.2 years, private NLPC: 38± 11 years, and private LPC: 37± 8.4 years. Median work experience was 10 years (range: 1-42 years).

Fig 2: Number of health care workers across different types of facilities

Constructs of HBM:

Mean±SD perceived self-efficacy score was 10.4± 2.2 with 10.7± 1.5, 10± 2.5, and 11.3± 1.3, among PC, NLPC and LPC respectively. Mean±SD perceived benefits score of practicing UP was 12.3± 2.2 with 13± 1.7, 11.8± 1.8 and 13.1± 1.8 among PC, NLPC and LPC respectively. Mean±SD perceived susceptibility to blood borne infections was 4.5± 3 with 4.7± 2.9, 4.0± 2.9, and 5.9± 3 among PC, NLPC and LPC respectively. Mean±SD perceived severity of blood borne infections was 15± 3.1 with 16.2± 3.0, 14.3± 2.9 and 16.8± 3.1 among PC, NLPC and LPC respectively. Mean±SD of score for barriers to practicing compliance with UP was -7.2± 5.5 with -7.6± 5, -6.5± 5.8 and -8.9± 4.1 among PC, NLPC and LPC respectively (Table 1).

Table 1: Descriptive characteristics of health care workers working at first level care facilities in rural Swabi of Khyber Pukhtonkhwa, Pakistan (N=485)

Variables	Type of FLCF n (%)			Total N=485
	LPC n=112	PC n=56	NLPC n=317	
Health care worker type:				
MBBS prescriber	58(51.8)	27 (48.2)	0	85(17.5)
Non-MBBS prescriber	0	0	278(87.7)	278(57.3)
Licensedassistant	29(25.9)	28(50)	22(6.9)	79(16.3)
Non-licensed assistant	25(22.3)	1(1.8)	17(5.4)	43(8.9)
Age (years):				
15-29	21(18.8)	5(8.9)	60(21.5)	94(19.4)
30-39	42(37.5)	21(37.5)	131(41.3)	194(40)
40-49	41(36.6)	17(30.4)	74(23.3)	132(27.2)
≥50	8(7.1)	13(23.2)	44(13.9)	65(13.4
Mean age (SD)	37±8.4	41±9.2	37.6±11	37.9±10.3
Work experience quartiles:				
<5 yrs	26(23.2)	11(19.6)	90(28.4)	127(26.2)
5-10 yrs	27(24.1)	10(17.9)	83(26.2)	120(24.7)
11-17 yrs	38(33.9)	14(25)	75(23.7)	127(26.2)
>17 yrs	21(18.8)	21(37.5)	69(21.8)	111(22.9)
Median years of work experience (range)	11(1-31)	15(<1-36)	10(<1-42)	10(<1-42)
Professional qualification of respondents:				
None	25(22.3)	1(1.8)	53(16.7)	79(16.3)
MBBS/MD/BDS	58(51.8)	20(35.7)	0	78(16.1)
RN & Paramedics	28(25)	34(60.7)	181(57.1)	243(50.1)
Diploma Homeopathy	1(0.9)	1(1.8)	83(26.2)	85(17.5)
Complete hepatitis B vaccination	68(60.7)	43(76.8)	84(26.5)	195(40.2)
Knowledge regarding modes of transmission of blood borne pathogens	13.5±4.1	12.1±3.7	9.6±4.1	10.8±4.4
Perceived Self efficacy in carrying out UP	11.3±1.3	10.7±1.5	10±2.5	10.4±2.2
Perceived benefits of compliance with UP	13.1±1.8	13±1.7	11.8±1.8	12.3±2.2
Perceived susceptibility to blood borne infections	5.9±3	4.7±2.9	4.0±2.9	4.5±3
Perceived disease severity after NSI	16.8±3.1	16.2±3.0	14.3±2.9	15±3.1
Perceived barriers to compliance with UP‡	-8.9±4.1	-7.6±5	-6.5±5.8	-7.2±5.5
Compliance with UP	33±8.1	31±5.5	28±7.8	30±7.8
Only SI related compliance with UP*	16.8±2.7	16.4±2.2	15.4±3.3	15.9±3.1

LPC=private licensed practitioner clinic, PC=Public clinic, NLPC=Private non licensed practitioner clinic, MBBS/BDS/MD = Bachelor of Medicine, Bachelor of Surgery/Bachelor of Dental surgery/Doctor of Medicine RN=Registered Nurse, UP=Universal Precautions

All continuous variables are presented as mean±Standard deviation or median (range) as appropriate
‡ Scale for measuring barriers to standard precautions was bipolar where negative score represent presence of barriers and vice versa; *wearing gloves when anticipated blood or body fluid exposure, disposing of contaminated needles, scalpels, razors and other sharps in sharp containers, disposing of blood contaminated items into designated bucket or bags, not recapping contaminated needles

Compliance with UP:

Mean±SD UP compliance score was 30± 7.8, with 31± 5.5, 28± 7.8 and 33± 8.1 among PC, NLPC and LPC respectively (Table 1). Overall 6.6% of the HCW responded "often or always" compliant to all the eleven components of UP. Among prescribers the compliance was lesser than the assistants (5% vs. 10%; p=0.03). Licensed prescribers were more compliant than non-licensed prescribers (9.4% vs. 4.3%; p=0.001). Also, assistants with professional qualification were more compliant than assistant without qualification (8.8% vs.

4%; p=0.001). In addition, Compliance was 11.6% at LPC, 5.3% at PC, and 4.4% at NLPC. Table 2 shows self-reported compliance with individual items of UP. Moreover, self-reported "always or often" compliance with not recapping contaminated needle was poor among HCW from all the three types of clinics (PC=32%, LPC=33%, and NLPC=15%). Compliance with wearing eye goggles, water proof apron, and face mask was less than 50% among all the three types of clinics.

Table 2. Self-reported "always/often" compliance with individual components of Universal Precautions at first level care facilities in rural Swabi of Khyber Pakhtonkhwa (N=485)

Components of Universal Precautions scale	PC[a] n=56 N (%)	Private LPC[b] n=112 N (%)	Private NLPC[c] n=317 N (%)	Total N=485 N (%)
I protect myself against the blood and body fluids of all patients, regardless of their diagnosis	31 (55.4)	81 (72.3)	162 (51.1)	274 (56.5)
I put used needles and other sharp objects into the designated sharps container	44 (78.6)	96 (85.7)	250 (78.9)	390 (80.4)
I wear gloves whenever there is a possibility of exposure to blood or other body fluids	30 (53.6)	76 (67.9)	99 (31.2)	205 (42.3)
I wash my hands after removing disposable gloves	45 (80.4)	97 (86.6)	230 (72.6)	372 (76.7)
I wear a waterproof apron whenever there is a possibility of blood or other body fluids splashing on my clothes	8 (14.3)	13 (11.6)	24 (7.6)	45 (9.3)
I wear eye protection (goggles/glasses) whenever there is a possibility of blood or other body fluids splashing in my face	7 (12.5)	33 (29.5)	47 (14.8)	87 (17.9)

I wear a surgical mask whenever there is a possibility of blood or other body fluids splashing in my face.	9 (16.1)	42 (37.5)	60 (18.9)	111 (22.9)
I do not recap needles that have been contaminated with blood	18 (32.1)	37 (33)	47 (14.8)	102 (21)
I dispose of all blood-contaminated items into the designated bag or bucket for disposal	37 (66.1)	96 (85.7)	232 (73.2)	365 (75.3)
I take extra care when using scalpels, needles, razors or other sharps objects	44 (78.6)	85 (75.9)	188 (59.3)	317 (65.4)
I cover any broken skin before coming to work	38 (67.9)	92 (82.4)	213 (67.2)	343 (70.7)

Data shows proportion of HCWs who reported "always/often" compliance with particular component
a. Public clinic: e.g. basic health unit and public dispensary which is the property of the government of Pakistan.
Offering services free of change.
b. Private licensed practitioners' clinic: Clinic which is the private property and the prescriber (doctor) is licensed practitioners from Pakistan medical and dental council.
c. Private Non-licensed practitioners' clinic: Clinic which is the private property and the prescriber (doctor) is having no license of practice from Pakistan medical and dental council

Predictors of compliance with UP:

In the univariate analysis, cumulative knowledge score about modes of transmission of HBV, HCV, and HIV, perception regarding self-efficacy in carrying out UP all the time, perceived benefits of practicing UP, perceived severity of bloodborne infection, and perceived susceptibility to bloodborne infections at workplace were significant positive predictors of compliance with UP. Multivariable linear regression analysis revealed significant positive association of knowledge of modes of transmission (adjusted ß coefficients (95% CI): 0.69(0.54 to 0.84), perception regarding self-efficacy in practicing UP (AdjB(95%CI: 0.60(0.28 to 0.93), perceived benefits of practicing UP (AdjB(95%CI: 0.40(0.05 to 0.75) and perception regarding susceptibility to BBP (AdjB(95%CI: 0.25(0.004 to 0.49) with UP compliance score. Barriers in practicing UP (AdjB (95%CI: -0.28(-0.41 to -0.15) and perceived disease severity (AdjB (95%CI): -0.37(-0.62 to -0.11) were negatively associated with compliance to UP. This main effect model explains 32% variation (adjusted R^2=0.32, P = <0.001) in the compliance of HCW with UP (Table 3).

Table 3: Univariate and multivariable analysis of factors associated with compliance to Universal Precautions among HCWs at first level care facilities in rural Swabi, Khyber Pakhtonkhwa, Pakistan

Variables	Univariate Analysis		Multivariable Analysis	
	β* (95% CI)**	p-value (α=0.25)	Adjusted β (95%CI)	P-value
Sociodemographic Characteristics:				
Facility by ownership: Public (n=56)Ref Private (n=429)	-1.55(-3.7,-0.65)	.168		

Variables	Univariate Analysis		Multivariable Analysis	
	β* (95% CI)**	p-value (α=0.25)	Adjusted β (95%CI)	P-value
Type of respondent: Assistant (n=122)Ref Prescriber (n-363)	-0.97(-2.6,-0.65)	.240		
Professional qualification: None (n=79) Ref MBBS/MD (n=79) B.Pharm/RN/Dispenser (n=218) Others (n=109) ¶	5.76(3.36,8.16) 0.59(-1.39,2.57) 1.05(-1.18,3.28)	<.001		
FLCF by major provider: Public physician (n=29) Ref GP (MBBS)(n=58) Non-MBBS(n=278)	1.6(-0.86 , 4.1) -2.7(-4.8 , -0.47)	<.001		
Years of schooling: ≤10 years (n=45)Ref >10 & ≤12 yrs(n=254) >12 & ≤14 yrs(n=104) >14 & ≤16 yrs(n=109	0.16(-2.28,2.60) 0.24((-2.45,2.94) 5.19(2.39,8.0)	<.001		
At least one NSI last 1 year: No (n=388)Ref Yes(n=97)	-2.61(-4.36,-0.86)	.003		
BBP transmission knowledge (HBV,HCV,HIV)[a]	0.85(0.71 , 0.99)	<.001	0.69(0.54,0.84)	<0.001
Constructs of Health Belief Model:				
Self-efficacy in practicing UP [b]	1.33(1.05,1.6)	<.001	0.60(0.28,0.93)	<0.001
Barriers to practicing UP [c]	-0.46(-0.58,-0.34)	<.001	-0.28(-0.41,-0.15)	<0.001
Perceived benefits of practicing UP[d]	0.74(0.38,1.0)	<.001	0.40(0.05,0.75)	0.026
Perceived Severity of Blood borne infections[e]	0.36(.14,.58)	.001	-0.37(-0.62,-0.11)	0.005
Perceived Susceptibility to BBP at workplace[f]	0.32(0.09,0.54)	.006	0.25(.004,0.49)	0.046

Outcome variable: Compliance with universal precautions is measured through 11 items likert scale (0-44) and one binary item having total score ranging from 0-45. Each one unit increase shows degree of compliance with UP.
   a. Scale consist of 21 binary items (range 0-21)
   b. Scale consist of 4 likert items (range 0-12)
   c. Scale consist of 11 bipolar liker items (range -22 to +22)
   d. Scale consist of 3 likert items (range 3-15)
   e. Scale consist of 4 likert items (range 4-20)
   f. Scale consist of 3 likert items (range 0-9)
*Un-adjusted Beta coefficient
** 95% confidence interval for beta coefficient
Ref = reference category
Others: DHMS, Alternative Medicine, Xray technician, EPI technician, Lab technician, Nurse Technician, dental technician.
Multivariable Model coefficient of determination (Adj.R2) =0.32, Overall significance of the final model (p) <0.001

Discussion

Health care workers (HCW) reporting "always or often" compliance with all the eleven components of universal precautions (UP) in this study was very low (6.6%) as compared to the multicenter rural community based hospital study in India [4] which found 11% "always or often" compliance among HCW to all the eleven components of the UP. In contrast, a study done in three regional hospitals in USA, [14] found that 23.7% HCW reported "always or often" compliance to the same scale of UP. Self reported "always or often" compliance with the individual components of UP such as not recapping contaminated needles was only 21% in current study which was consistent with a previous study at first level care facilities (FLCF) in southern parts of Pakistan in province of Sindh [3] which reported 20.8%. Compliance with not recapping contaminated needles in our study was also similar to the study in Sindh Province among categories of HCW: 33% vs.35.7% among MBBS/licensed practitioners, 14.8% vs. 18.2% among non-MBBS/non-licensed practitioners and 19.7% vs. 17% among assistants, respectively. In contrast, in Indian rural hospitals [4] and three regional hospitals in USA [14] who used the same Likert scale of UP, reported~2 times higher compliance (60.2% and 72.8% respectively) with "always or often" not recapping contaminated needles than our estimates. Also compliance with sharp disposal in a separate container, hand washing, proper disposal of blood contaminated items, and taking extra care while using needles, scalpels and razors was almost more than 50% among HCW from all the three types of clinics which is consistent with the findings of the study from India. [4] In addition, HCW from private LPC were relatively better compliant as compared to public and private NLPCs. We used the same 11 items likert scale for measuring UP as was used in India, [4] and America. [6, 14] The difference between our estimate and other studies could be related to the difference in setting such as FLCF vs community hospitals and also variation in availability of the personal protective equipment (PPE).

Very low compliance to "not recapping contaminated needles" in this study is alarming and hence requires immediate attention and action. Numbers of studies have identified association between needle recapping and needle stick/sharp injuries. [6, 15, 16] Also majority of the HCW in district Swabi were from NLPC and had relatively poor knowledge regarding modes of transmission of blood borne pathogens (BBP), and very poor compliance to all the components of UP. Recapping needles can put these HCW at the risk of bloodborne infections if left unattended.

Compliance with UP is determined by a range of factors including higher knowledge about modes of transmission, [3, 4, 14, 16] few barriers in practicing UP (time constraint, inconvenience, presumption that patient was not infected, not wanting to offend patients, lack of equipment, conflict of interest), [3, 4, 17, 18] work stress, [16] perceived organizational commitment to safety, [4, 14, 16] risk perception, [3, 14] not risk taking personality, [14] and increased length of job in the facility. [3, 4] In this study, factors that were associated with compliance to UP included knowledge regarding modes of transmission of BBP and constructs of HBM including higher self-efficacy in practicing UP, fewer barriers to practice of UP, higher perceived benefits of practicing UP, and higher perceived susceptibility to BBP at workplace. These results are consistent with the current literature. [4, 14]

Our finding about association between knowledge regarding modes of transmission and compliance with practicing UP is consistent with number of studies conducted in almost similar setting among HCW from Sindh-Pakistan [3] and India. [4] HCW with knowledge regarding modes of transmission of BBP might have better perception regarding susceptibility to workplace infections, and benefits of compliance with UP. Thus, knowledge for modes of transmission of BBP works through the constructs of HBM in predicting compliance with UP. Improving knowledge could be the first step towards improving the occupational safety of HCW working at FLCF in such settings in Pakistan. Interventions such as ongoing training, and awareness regarding modes of transmission of BBP especially in villages might be helpful in improving modes of transmission knowledge and thereby UP compliance.

Another construct of HBM is perceived self-efficacy which is defined as "people's belief

about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives". [24] Strong perception about self-efficacy results in people's high assurance in their capabilities thereby approaching difficult tasks as challenges to be mastered rather than as threats to be avoided. In contrast, people who doubt their capabilities shy away from difficult tasks which they view as personal threats and have low aspirations and commitment to the task they choose to accomplish. [24] Our results showed that perception about self-efficacy in practicing UP during different circumstances was positively associated with compliance to UP. A study among nurses working at different tertiary care hospitals in China also found that the odds of compliance with UP was 1.3 times higher among nurses with higher self-reported score on validated self-efficacy in practicing UP as compared to those with lower score. [25] Another study from Cyprus also found that constructs of HBM including self-efficacy influence nurses' compliance with UP. [8] According to Bandura, perception regarding self-efficacy can be developed through mastery experiences e.g. successful application of UP, vicarious experiences provided by social models e.g. seeing colleagues and friends practicing UP in different circumstances, and social persuasions e.g. verbal boost and encouragements that they possess the capabilities to master the given activities. [24] Future interventions targeting compliance with UP should focus on strengthening the self-efficacy by providing hands on experience in performing different procedures while using the UP.

This study found negative correlation between perceived disease severity (risk of bloodborne infection) and compliance with UP which is also consistent with the findings in India [18] and USA. [14] As the perception about the severity or risk of certain condition or disease increases, the likelihood of taking preventive measures should also presumably increase. HBM also theorizes that behaviors of individuals are predicted by the six constructs including perceived severity of the condition. [19] It states that behaviors could be modified if the perceived severity of the condition or disease as a result of that behavior is more severe. Several possibilities could be considered for the negative association between perceived severity and compliance. The more plausible explanation could be a reverse causality [20] because of needle stick/sharp injuries(NSI/SI). Those who do not comply with UP are more likely to sustain needle stick or SI [16, 18] thereby increasing the perception regarding risk of blood borne infections.

This study also found that perception regarding barriers to compliance with UP were negatively associated with using UP. Association between compliance with UP and barriers to compliance is well established. Several studies from different countries such as Pakistan, [3] India, [4, 29] USA, [23] Cyprus, [8] and China [7] have shown negative impact of barriers on compliance with UP. For a successful program or intervention to improve the compliance with UP, it is important to identify and address the perceived barriers of HCW first. Besides, we also found that perception regarding benefits of compliance with UP and perceived susceptibility to BBP at workplace were positively associated with compliance to UP. Evidence is lacking regarding the association between perceive benefits and compliance with UP or perceived susceptibility and UP. Thus, our results show that addressing any individual factor to improve the compliance with UP will not work in isolation however addressing both structural barriers, individual attitudinal and behavioral factors together might be effective in improving the compliance with UP.

Results of this study provide evidence that constructs of HBM better explain the compliant behavior of HCW with practicing UP. Therefore, effectiveness of interventions based on HBM to enhance the compliance with UP among HCW at FLCF should be investigated through experimental design.

In summary, HCW working at FLCF in Swabi have poor compliance with UP. Knowledge regarding modes of transmission of BBP, self-efficacy in carrying out UP, perceived benefits of UP and perceived susceptibility to BBP were associated with compliance to UP. Program aiming at comprehensive education and training about modes of transmission of BBP, UP, and provision of essential hepatitis B vaccination for all the HCW at FLCF and PPE could help improve the compliance with UP at FLCF.

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