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Challenges and Adherence to Standard Precautions for Prevention of Percutaneous Injuries and Exposure to Blood Borne Pathogens in Clinical Practice: A Review

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Abstract

Background: Standard Precautions (SP) was introduced by Centre for Disease Control to minimise the risks of disease transmission in the process of healthcare. Many factors are thought to influence the knowledge and the practice of these measures. **Objective:** To review challenges and adherence to SP for the prevention of percutaneous injuries and exposure to patients' blood in clinical practice. **Methods:** The World Wide Web sites such as, Pub Med central, Google scholar were searched using key words such as percutaneous, needle stick injuries, standard precautions, adherence. Relevant articles were reviewed and included based on defined criteria. **Results:** The prevalence of needle stick injuries (NSI) varies among health care workers (HCWs) and across countries and is as high as 73% among some groups. The knowledge of SP varied among HCWs in different nations; however the practice of SP was noted to be lower than knowledge across most studies. Majority of HCWs in developing countries that sustained NSI failed to report the incident to appropriate authorities. Adherence to Standard Precautions is influenced by lack of proper training, poor supplies, low commitment of HCWs and health facility managers etc. **Conclusion:** Needle stick injuries and exposure to patients' blood remain a risk for disease transmission among HCWs. Despite appreciable knowledge of standard precautions, the practice has remained low across the globe. Factors that had positive influence on practice of SP such as use of devices with safety features, adherence to infection control guideline, comfortable working environment, repeated and intense training etc. should be adopted and promoted.

Keywords

Percutaneous Injuries, Prevention, Standard Precautions, Adherence

1. Introduction/Background

Health care workers (HCWs) are at risk of acquiring blood and body fluid borne infections such as hepatitis and human immune deficiency virus (HIV) etc. through accidental injuries and direct exposure to body fluids [1] [2] [3]. These body fluids include cerebrospinal fluid (CSF), peritoneal fluid, pleural fluid, pericardial fluid, synovial fluid breast milk, semen and urine. Saliva, vomitus, perspiration, sputum and nasal secretions are less established sources of infection [4]. The World Health Organization (WHO) had reported a worldwide annual proportion of HCWs exposed to blood borne pathogens as 2.6% for hepatitis C virus (HCV), 5% for hepatitis B virus (HBV) and 0.5% for HIV. Meanwhile, 40% - 65% of HBV and HIV infections among HCWs are due to percutaneous injuries. The risk of injuries at work place is higher in developing countries compared to the developed nations [5] [6]. This is attributable to more prevalent blood borne pathogens in low income countries especially sub Saharan African countries.

The effect of percutaneous injuries ranges from psychological trauma through chronic diseases to death [7] [8]. The safety of HCWs is therefore a global health concern [9] as it is important that measures are in place for protection. Universal Precautions which later translated to Standard Precautions was introduced by Centre for Disease Control (CDC). Many developed countries and few developing countries have introduced needle stick injuries prevention activities guidelines, for example the USA needle stick safety and prevention Act was enacted 2000 and became active in 2001 [10]. The European Union legislation to improve safety and health of workers was introduced in 1989 and in 2010 the European council adopted Directive 2010/32/EU on prevention from sharp injuries in the hospitals and healthcare sector, which was specifically developed to protect HCWs from risk of occupational NSI and subsequent infection with HIV and other blood borne pathogens [11].

Universal precaution is defined by the Centre for Disease Control (CDC) as a set of precautions or actions designed to prevent the transmission of HBV, HCV, HIV and other body fluid or blood borne pathogens when providing first aid or health care [4]. The aim is to protect both the HCWs and the uninfected patients [4]. It is composed of four standard practices comprising hand washing, safe handling and disposal of sharps, safe decontamination of instruments and the use of protective barriers like aprons, gloves, goggles and boots. Additional protection may, however, be required in cases of mumps, rubella, tuberculosis, influenza and pertusis. The practice was first introduced in 1985 but was readjusted in 1987 by a set of rules known as Body Substance Isolation [12]. Then, in

1996, universal and body substance isolation were replaced by the latest approach known as Standard Precautions [12].

However, Universal Precautions have continued to be implemented worldwide, though, the knowledge and implementation have continued to be subjects of debate. And even where the knowledge and understanding of universal precautions appear adequate, financial limitations in low resource settings may limit availability and has also been seen as discrimination against patients and considered stigmatization especially against HIV patients [13] [14].

The above limitations and the continued exposure of HCWs to injuries and blood-borne infections are the reasons studies regarding universal precautions and percutaneous injuries have continued.

Our objective is to review available literatures on prevalence and incidences of percutaneous injuries and accidental exposure to patients' blood and the challenges of and adherence to standard precautions among medically exposed individuals.

2. Methods

Search methods

The World Wide Web was searched using key words and their various combinations such as:

Percutaneous Injuries, Prevention, developing countries.

Percutaneous injuries, health worker, prevention, developing countries.

Percutaneous Injuries, Prevention, developed countries.

Percutaneous injuries, health worker, prevention, developed countries.

Percutaneous injuries, standard precautions, health workers, clinical practice.

Percutaneous injuries, universal precaution, health workers, clinical practice.

Exposure to blood borne pathogens and standard precaution.

Percutaneous injuries, Standard precaution, adherence, challenges, developing countries.

Percutaneous injuries, Standard precautions, adherence, challenges, developed countries.

Percutaneous injuries, Standard precautions, adherence, challenges, hospital management, developed countries.

The web sites searched include Pub Med central, African journal on line, PubMed UK, Medscape, Google scholar, Google web and Medknow. The web search was limited to articles published between the years 1999 to 2018. We identified articles both full and abstracts and other publications that researched into prevalence of percutaneous injuries and exposure to patients blood, attitude, knowledge and application of standard precautions to prevent blood borne pathogens, Also articles that involved hospital management predispositions to staff training in the used of standard precautions and provision of the requirements for the practise of standard precautions were also assessed and evaluated.

The data extraction focused on:

The year of Publication

Country and the region in which research was conducted.

The type of study

The study population and its characteristics and the number of research subjects.

Parameters extracted include, year and country of study, the number of subjects and type of study, prevalence and incidence of percutaneous injuries or exposure to patient blood among health workers studied, group of health workers studied, incidences of exposure reported, level of knowledge of and attitude to standard or universal precautions, practice and adherence of health workers to standard precautions, challenges to good practice of standard or universal precaution, reported methods and factors that improve practice of and adherence to standard or universal precautions.

The Inclusion criteria include:

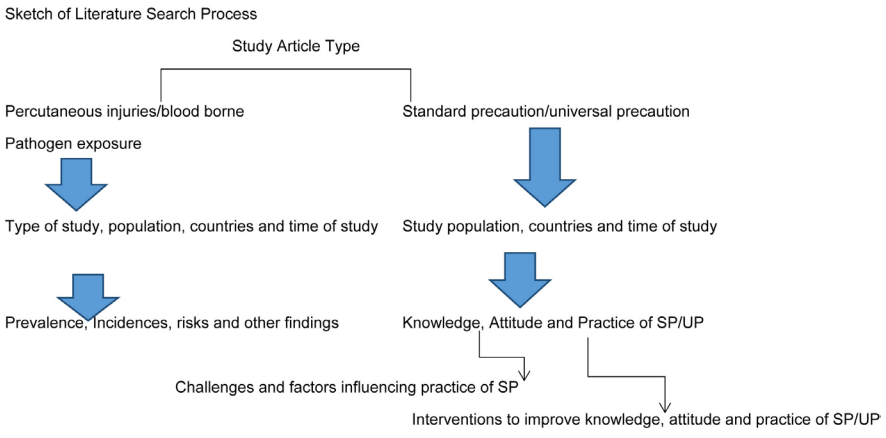
1) Original research articles on the subjects that are either cross-sectional studies, descriptive or randomised studies that focused on prevalence of percutaneous injuries and exposure to patients blood borne pathogens, knowledge, attitude, practice and determinants of practice towards standard precautions for prevention of blood borne pathogens.

2) Research articles focusing on attitudes of health management to practice of standard precautions and provision of equipment necessary for prevention of percutaneous injuries and exposure to patients' blood.

3) Articles published in the last 20 years between 1999-2018, to accommodate differences and possible advancements in the protective equipment and other practices between developed and developing countries.

Review methods:

The abstracts and full articles downloaded from the web were independently read and evaluated by two of the authors for relevance and possible selection. Articles that met the inclusion criteria were selected for in-depth review.



3. Result

A total 529 articles and abstracts were evaluated for inclusion criteria. 67 articles

were reviewed and chosen from developing countries while 24 articles were selected after review from developed countries. The articles from developing countries had 23302 subjects studied while those from developed studied 8945 subjects

Needle sticks injuries (NSI) and exposure to blood and body fluids (EBBF):

The prevalence and incidences of NSI and BBFE across health workers and medically exposure persons were recorded from 34 studies in the review. The prevalence varied depending on the population of healthcare workers or students studied. It ranged from 17% among HCWs in a tertiary hospital in India [15] to 54% and 72.1% - 73% among nurses and midwifery students in Iran [16]. Most common activity that led to NSIs among nurses was recapping of needle especially double hand recapping [17]. Studies that reported on incidence and prevalence of percutaneous injuries, needle stick injuries and exposure to blood and body fluid of patient are shown in **Table 1**. A study in Botswana involving 885 randomly selected HCWs reported PI prevalence of 48.9% which were significantly higher among nurses odd ratio 3.49 (CI = 2.02 - 6.08) $p \leq 0.001$ [18]. Parithram *et al.* in India reported NSI prevalence of 27.5% with 41.8% of them occurring during needle recapping [19]. Several studies across 6 different developing countries reported on prevalence of percutaneous injuries ranging from 19% to 67.9% and noted a preponderance of nurses in the range of 28% to 70% being mostly involved [20]-[27]. Bidira *et al.* in their study in Ethiopia reported that the risk of NSI was tripled in nurses with lower level of knowledge [28]. Varying percentage of staff that had needle stick injuries reported to appropriate authority. Bolarinwa *et al.* in their study among 247 primary health care workers in Nigeria found the least (19.5%) of those that had needle stick injuries reporting to appropriate authority, [29] Nwankwo *et al.* in their study among surgical resident in a training institution in Nigeria reported NSI prevalence of 67.5% and noted that 76.9% of the respondents involved ignored the incidents, Denic *et al.* in Kenya 40.1%, Raghavendran *et al.* 2006 in United Kingdom noted that 66% of nurses reported sustained needle stick injuries [23] [30] [31]. Guest *et al.* in the study among nurse in Australia reported that 90% of nurses reported NSI to appropriate authority when involved [21]. Perez-diaz *et al.* in their study in Columbia of 2403 HCWs exposed to blood borne pathogens, noted that NSI was the highest (86.5%) with one sero-conversion [32]. Hanafi *et al.* in their study reported that 8.2% of NSI involved high risk patients and only 25.3% of those involved in NSI reported, Physicians are most unlikely to report [33]. Omar *et al.* in Kuwait reported that the prevalence of incident exposure among at risk HCWs was 0.7% with NSI being the Commonest at 75.9% [34]. Guest *et al.* reported annual incidence of 7.2% (95% CI 5.9 - 8.7) in Australia which was higher in private hospitals (17.9% compared to public hospitals 15.2% %0% reported lack of safety engineered medical device in the centre [21].

In USA, Beckman *et al.* in their study of 153 hospital in Virginia USA reported annual PI of 5.3/100 personnel in 106 hospitals while Grimond *et al.* in their national survey of 125 hospital in 29 states reported sharp incidence of

Table 1. Prevalence and incidences of NSI and EBBF.

S/N	Authors and year	Country	Population/type of study	incidence	Prevalence	Group most affected	Reported Incidences %
1	Punia *et al.* 2014 [15]	India	Cross-sectional of 165 HCWs		17%	-	-
2	Jamu *et al.* 2016 [18]	Botswana	Cross-sectional of 885 HCWs		11%/6months	Nurses (OR: 4.1, Drs 4.2)	
3	Izadi *et al.* 2015 [22]	Iran	C/S of 309 HCWs	26.90%	-	Nurses (63.9%)	-
4	Jahangiri *et al.* 2016	Iran	168 registered nurses	76/56%	-		60.20%
5	Jayanth *et al.* 2009 [20]	India	C/S of 296 HCWs	Nurses 28.4%, Drs 21.6%	-	Nurses @ 28.4%	-
6	Parithran *et al.* [19]	India	200 Dental Staff	-	27.50%		-
7	Moodley *et al.* [23]	South Africa	Dental staff and students	-	22%	Students @ 76%	81
8	Mbaisi *et al.* [41]	Kenya	C/S, 305HCWs	-	19% NSI/25%	Nurses @ 50%	-
9	Denic *et al.* 2015 [31]	Serbia	C/S, 983HCWs	-	29.60%		40.2
10	Bolarinwa *et al.* 2011 [29]	Nigeria	C/S, 247 PHCWs	-	31%	-	19.5
11	Bidira *et al.* 2014 [28]	Ethiopia	C/S, 211 Nurses	-	39.30%		-
12	Talaat *et al.* 2003 [17]	Egypt	C/S, 1485 HCWs	-	35.6%/3months		-
13	Hanafi *et al.* 2011 [33]	Egypt	C/S, HCWs	-	63.3		-
14	Qazi *et al.* [75]	Pakistan	C/s 198 HCWs	-	50%		-
15	Kuruuzum *et al.* 2008 [76]	Turkey	C/S, 350 HCWs	-	58%	Nurses @ 74.6%	
16	Askarian *et al.* 2015 [16]	Iran	C/S, 137 HCWs	-	72.1 - 73.7%		
17	Nwankwo *et al.* 2011 [30]	Nigeria	Surgical resident doctors		(PI/EBBF) 67%		
18	Nouetchognou *et al.* [40]	Cameroon	C/S, 150 HCWs	-	36.7 EBBF		
19	Laisser *et al.* 2017 [77]	Tanzania	C/S, 277 Randomly selected HCWs	1.96/100person/year	59%		
20	Hysieh *et al.* 2006 [78]	Taiwan	HCWsover 3 years	4.4/100person/year		Nurses @ 60.0%	
21	Wang *et al.* 2015 [79]	China	Transfusion centre			Nurses @ 49.5%	
22	Bhardwaj *et al.* 2014 [80]	Malaysia	HCWs in orthopaedic ward		20.90%		
23	Moro *et al.* [81]	Dorminican Republic	HCWs in 440 hospital/clinics		22.30%		
24	Salehi *et al.* 2010 [3]	Afghanistan	C/S, 950 HCWs	12/230()	72%	Obygn @ 96.1%	

Continued

25	Zaidi *et al.* 2012 [82]	United Emirate	C/S, 230 HCWs				66
26	Raghavendran *et al.* [23]	United Kingdom	Survey of 258 Critical care staff	373PEI/3years, 7.2%	53%/years of practice		
27	Smith *et al.* 2005, [26]	Australia	Survey of 373 cases of PI		38.9% needle stick	63.50%	
28	Guest *et al.* 2014 [21]	Australia	256/1100 nurses	13,041 BBFE/yr	-		90%
29	Venier *et al.* 2007 [25]	France	HCWs In 375 Health Centres	249 exposure/yr	0.7/at risk HCW		
30	Omar *et al.* [34]	Kuwait	Retrospective, 249 HCWs	60 NSIs/2yrs 4 months	75% NSI		
31	Falafel *et al.* 2007 [83]	Greece	3.48/100FTEY and @risk staff	24.0/1000 Obs			
32	Grimond *et al.* 2013 [24]	USA	HCWs in 129 hospitals	4.8/100OBs/yr	100NSIs/100 OBs		
33	Yoshikawa *et al.* 2013 [35]	Japan	5463 HCWs from 67 Hosp				
34	Rice *et al.* 2015 [36]	England	10 years analysis of Per & muco-cutaneous Exposures		2957 *Sharp injury recorded* in 10 years		-
35	Wicker *et al.* 2008 [37]	Germany	Case control study involving 13358, 20163 & 13381 tested for HbsAg,		432/1342 (32.3%) NSIs		
35	Shiao *et al.* 2002 [39]	Taiwan	AntiHCV, & HIV 1085 patient tested for HBV, HCV, HIV		7550NSI by 8645 HCWs	-	23.3

OB = occupied beds, C/S = Cross sectional, HCWs = Healthcare worker.

24.0/1000 occupied beds [35].

In France Venier *et al.* surveyed 375 medical centres consisting of 15% of French medical centres and reported annual incidence of 13,031 Blood and body fluid exposures with NSI consisting 72%. Yoshikawa *et al.* in Japan in their survey of 5463 respondents selected from 67 Japanese hospitals reported NSI incidence of 4.8/100 occupied beds (95% CI 4.1 - 5.6) and sharp injuries tend to be higher in larger centres and in workers less than 40 years [25].

In England, Rice *et al.* reported 2957 sharp injuries involving source patients with blood borne infection in their 10 year review, with a trend that increased with years noting a higher episode of 67% higher in 2011 compared to 2002 [36].

Wicker *et al.* in their study estimated the risk of infection to common blood pathogen and reported highest risk of exposure was in internal medicine, 4.56, 5.88 and 6.16 for HBV, HCV and HIV respectively. The risks in Obstetrics and Gynaecology and Surgery departments were (0.37, 1.35 & 0.37) and 0.44, 1.07 & 0.16) respectively [37].

A study by Yoshikawa *et al.* in Japan, that surveyed 5463 participants in 67 hospitals, reported NSI incidence of 4.8/100 (95% CI, 4.1 - 5.6) the incidence tended to be higher among workers less than 40 years, and those working in pa-

tients room and operating theatres [38].

Shiao *et al.* in their study in Taiwan noted that 7550 NSIs were reported by 8645 HCWs with estimated 308 - 924 being at risk of contacting HBV, 334 - 836 for HCV. Nurses had the highest risk for NSI (543) and for contacting HBV (543) and, HCV596) 1762 HCWs are at risk of sero-conversion annually with 64.7% likely to be nurses [39]. Mbaisi *et al.* in their study of 305 respondents reported preponderance of nurses were involved in PI during stitching and in the Obstetrics and gynaecology [40]. Nouetchognou reported that 36.7% of 150 HCWs studied were exposed to blood and body fluids, majority of them worked in surgical depaetment [41].

Knowledge, Attitude and Practice of Universal or standard precautions for prevention of PI/NSI/EBBF in developing and developed countries:

Developing Countries:

Table 2 shows some of the indices of knowledge, attitude and practice of standard precautions. Knowledge level of standard precautions and protective equipment varies from 15% recorded by Abdulrahem *et al.* in Northern Nigeria to 90% by Ogoinia *et al.* reported in the Southern Part of the same Country [42] [45]. Bolagii-Osagie *et al.* in their study in Nigeria reported high knowledge of UP among midwives and that more than 50% practice UP [44]. Ibeziakor *et al.* 2006 and Ndu *et al.* 2017 reported SP knowledge of 50% and 76.2% respectively; the later reported that safety practice was higher among Doctors than other health workers [45] [46].

The practice of SP was lower than knowledge across most studies. Sado *et al.* in Western Nigeria reported 31.9% of HCWs studied always recap needle with preponderance among trained nurses [47]. Amora *et al.* studied 421 HCWs in Northern Nigeria and reported that 77.9% had good knowledge of SP, 8.1% had had any form of training on SP, they reported poor compliance to UP, with 98.0% indicating lack of protective equipment as reason for non compliance [48]. Reda *et al.* in their study of 475 HCWs in 10 hospital and medical centres in Ethiopia reported 46.9% had knowledge of SP with 30.5% being positively disposed to it and 80% regularly observe SP in the practice [2]. Tesfay *et al.* reported that 92.4% of 234 HCWs drawn from 4 hospitals in the region knew all type of protective equipment but only 50% made use of them [49]. Gebresilassie *et al.* studied 483 HCWs in Ethiopia and reported that 42.9% had good practice of SP, with the odd of good practice of SP being 2.5. About 2/3 of the studied population has had training in SP [50]. Eskander *et al.* and Mortada *et al.* in their studies of nurses and doctors in Egypt reported that 57.1% and 57.5% complied with standard precautions in their duties, while 63.6% of nurses had unsatisfactory knowledge [17] [51]. While Hanafi *et al.* reported a knowledge and practice levels of 58.7% and 46.3% respectively in the same country [30]. In Uganda, Wasswa *et al.* studied 202 HCWs and reported SP knowledge level of 6/8 (75%) while 72.6% had been trained in SP [52].

Pati *et al.* in Odisha India studied 32 HCWs working in Sub-district hospital

Table 2. Attitude knowledge and practice of standard precaution.

S/N	Author/year	Country	Population/Type of study	Good/ adequate Knowledge	Positive Attitude	Gen Practice	Hand washing	Wearing of gloves	Wearing of Apron/masks	Eye protection	Don't recap Needle	Proper Sharp disposal
1	Punia *et al.* 2014 [15]	India	C/S, 162 HCWs		-	-	95%	77%	28%	22%	-	-
2	Pati *et al.* 2013 [2]	India	32 HCWs in Sub District Hospital	90.90%			50%		31%	38%		
3	Jain *et al.* 2012 [54]	India	329 nurses and 71 doctors	55.30%	-	52%		-			-	-
4	Das *et al.* 2016 [84]	India	C/S study of 132 interns	Hand washing 82%, wearing gloves 82.6%			64%				47.90%	62.50%
5	Holla *et al.* 2014 [55]	India	C/S, 178 health care professionals		97.20%		75.50%	77.50%	46.60%	31.50%	51.70%	87.60%
6	Askarian *et al.* 2002 [16]	Iran	C/S study of 137 dental & 208 midwifery students	85%				24.1%; 2% double gloved		97% midwifery and 47% dental students		
7	Asadpour *et al.* 2013 [85]	Iran	C/S, 135 physicians and medical student	72.4% (32.6/45)	75.1% (33.1/44)							
8	Fashafsheh *et al.* 2015 [86]	Palestine	C/S; 271 Nurses	53.90%		91.1% had good practice						
9	Halboub *et al.* 2015 [87]	Yemen	145 dental students				-	96.60%	53.80%	14%	-	-
10	Qazi *et al.* 2016 [75]	Parkistan	C/S of 198 HCWs	Awarenes 59.9%				91% - 100%		-		19.70%
11	Reda *et al.* 2010 [2]	Ethiopia	C/S Survey 475 HCWs in 10 Hospitals		53.10%	80% regular		-				
12	Jakob *et al.* 2015 [88]	Ethiopia	C/S, 135 HCWs	-		42.20%	-	-	-		-	-
13	Akudunan *et al.* 1999 [57]	USA	597 HCWs in 76 operating room procedures		-		26% double glove		76% any form			-
14	Doebbling *et al.* 2003 [58]	USA	3223 HCWS in Community Hosp			32% - 54%				-	29-70%	32% nurse, 28% doctors
15	Raghavendran *et al.* 2006 [23]	United Kingdom	258 HCWs (Drs, Nurses & operating Rm staff	-		64% always, Drs. 31%	56.60%				57%	

Continued

16	Permanggiani *et al.* 2010 [60]	Italy	C/S study 550 ED HCWs	-			86.60%	88.60%		35.80%	50.10%	90.50%	
17	Jeoeg *et al.* 2008 [61]	South Korea	158 Nurses from 7 general hospitals		-	-	-	12 % always double glove	-	2%	10%		
18	Abdulrahem *et al.* 2012 [42]	Nigeria	251 HCWs	13%					2.50%				
19	Ogoina *et al.* 2015 [43]	Nigeria	270 HCWs	90%	95%	50.80%	-		-		-	-	
20	Otovwe *et al.* 2017 [89]	Nigeria	200 HWCs	79%		91.50%							
21	Johnson *et al.* 2012 [90]	Nigeria	360 HCWs	54% - 64.2%		53% - 64%		86.60%		-			
22	Ibeziako *et al.* 2006 [45]	Nigeria	C/S, 246 HCWs	50.40%			43.90%						
23	Sadoh *et al.* 2006 [47]	Nigeria	C/S, 433 HCWs				94.60%	638%			33%		
24	Hanafi *et al.* 2011 [33]	Egypt	C/S of HCWs	58.70%		46.30%			63.80%				

and reported that knowledge level in 90%of respondents scored 12/19 (63.2%) in scale of knowledge, but the score for practice was quite lower 5/19 (26.3%) (p = 0.049) [53]. The attitude to SP was poor as only 28% believed that SP was only necessary when treating patients with HIV. Jain *et al.* reported suboptimal knowledge (55.3%) of SP in their cross sectional study of 329 nurses and 71 doctors in the same country with only 57% of them applying maximal barrier precautions [54]. Holla *et al.* in India reported quite high positive attitude to some components of SP such as Hand washing after removal of gloves, needle recapping, proper needle disposal and covering broken skin before attending to patients [55].

Two studies in Iran evaluated KAP among medical trainees. Barikari *et al.* reported mean knowledge score of 6.6/10 (66%), practice at 18.8/30 and attitude 10/16.6. while Askarian *et al.* noted that 85% of dental and midwifery students studied had received information on SP [16] [26]. Luo *et al.* in China studied 1444 nurses and noted 64.7 had 48.29/80 score for over all compliance of SP [56].

Developed Countries

Akduman *et al.* studied 597 HCWs in surgical specialties, observing them while performing procedures; he reported that only 28% double gloved, 32% wear regular eye glasses and 24% used no eye protection [57]. Doebbeling *et al.* studied 3223 HCWs in Iowa community hospitals and reported that 32% - 54% practiced hand washing, 27% - 70% avoided needle recapping, 30% had PI in 3 months, trained nurses are mostly at risk 32% as against 28% of physicians, 22% - 62% under reported PI to appropriate authority [58]. Amin *et al.* reported low

knowledge of SP across all domains with the least of 26.7% being in sharp injuries among students of King Faisal University in Saudi Arabia [59]. Raghavendran *et al.* reported on 258 HCWs (involving doctors, nurses, operating room staff) in United Kingdom, 64% almost always followed SP but only 31% of doctors did [23]. Permeggiani *et al.* in their study of 550 randomly selected HCWs in Italy reported high knowledge of and attitude to SP but low compliance concerning Standard precautions [60]. Jeong *et al.* studied 158 scrub nurses in South Korea and reported poor compliance with SP, only 12% always double gloves, 2% always wear protective eye equipment and 10% always recap needles [61].

Factors Affecting Compliance to Standard Precautions:

Adinma *et al.* in their study of HCWs in Nnewi Nigeria reported lack of provision of adequate protective equipment as most important factor influencing compliance to SP. Others are Carelessness, lack of display of universal precautions guide line, emergency nature of intervention, insufficient water supply, patients perceived to be high risk for blood borne infection, pressure for time, use of protective equipment interfering with skill. Kio *et al.* reported in the same country among student nurses and staff, high job demand, unavailability of protective equipment, perception that patient involved did not pose a risk and high cost of equipment and materials required [62]. Nmadu *et al.* studied 32 Primary health workers and reported that lack of knowledge, perception of negative influence of personal protective equipment were individual factors for non compliance with SP. Heavy work load and Emergency situations were work related factors involved. Organizational factors include lack of PPE, lack of training and support from facility management [63]. Gebresilassie *et al.* in their study in Ethiopia reported that odd of good practice was 2.5 higher among young HCWs than older age, more likely to be reduced in males than female. Doctors and nurses had 80% and 70% odd of reduced practice than laboratory HCWs. There was 1.8 increase likelihood of SP practice when written communication is displaced [50]. Tesfay *et al.* in Ethiopia reported that extended working hours more than 40 hours/week, work experience less than 50 years and workers using protective equipment are more likely in 1.2, 1.4, and 1.6 to have occupational exposure; but that those that had been trained were 0.78 likely to be exposed [49]. Hanafi *et al.* in Egypt reported frequency of NSIs were reduced by access to devices with Safety features (OR 0.41 CI 95 021 - 0.7), adherence to infection control guidelines(OR 0.42 CI 95 0.26 - 0.71), having been trained in safety and appropriate work practice (OR 0.14 95 CI 0.03 - 0.4), comfortable room temperature (OR 0.32 CI 95 0.06 - 0.67), available written protocol for prompt reporting (OR 0.37 CI 0.02 - 057), significant predictor of SP was knowledge of infection transmission following NSI [33].

Cheng *et al.* using indebt interview of HCWs noted that service providers reported selective adherence to SP in their daily practice [64]. Factors leading to non adherence to SP included lack of time to put on the protective equipment, that protective gear interfere with performance of medical procedure, lack of administrative support, heavy work.

Efstathiou *et al.* studied 30 nurses selected from various department and reported that barriers to compliance include lack of protective equipment, use of some equipment reduce skill, patients discomfort or distress, too busy or perception that implementation of guide line is time consuming, that in providing nursing care to children that SP may be unnecessary, putting on equipment has negative effect on patient, nurses may be embarrassed using equipment nor commonly used in their environment, working experience and influence of physicians [65].

Vaughn *et al.* in their study of 1454 HCWs and infection control staff in Iowa USA reported that positive predictors of consistent adherence are Hours per full time employee (1.03), Frequency of SP education (OR = 1.11), Facilities providing personal protective equipments and Met support need for safety. Negative predictive factors are Blood and body Fluid Precautions isolated Category (0.074) and Increased job demand (OR = 0.9) [66]. Stringer *et al.* reported in their observational study of 3765 operation in Canada, that hand free technique was effective in preventing incidence of PI when blood loss is more than 100 mls [67].

Education and Practice of SP/UP

Lutfe *et al.* in Bangladesh studied the role of education and training on practice of SP among 141 HCWs in secondary care hospitals, and reported significant improvement in compliance to SP and remarkable reduction in NSI, decreasing from 47.5% to 8.3% (p = 0.0001) [68]. Obi *et al.* in their study of 304 HCWs working in a medical centre in Nigeria reported strong association between practice of SP and level of education (p = 0.001), training on SP, and how recently training has taken place [69].

Maheswari *et al.* in India studied the effect of structured training among class IV employees working in a college hospital and reported knowledge level increasing from 51% to 93% [70]. Mahrous reported in his study, that score of knowledge and practice were increased after participation in education programs and that there was strong correlation between knowledge, practice and educational level [71].

Li li *et al.* in their study of 1760 health care providers from 40 county level hospitals in China reported that training on Universal precautions was associated with better knowledge of and adherence to UP and that perceived availability of UP supplies in the hospitals, UP training, knowledge and adherence were significantly associated with avoidance attitude towards PLWA in medical practice [72].

McCoy *et al.* studied 149 (62%) community hospitals in Iowa and Virginia in United State of America and reported an association between ICPs assessment of HCWs training and workers who reported having sufficient information to comply with SP. Management commitment to SP training, leadership support, frequency of providing blood borne pathogens information safety climate were predictors for assessed adequacy of training. They concluded that institutional safety climate, leadership support and frequent education are important in HCWs training adequacy to monitor co-worker adherence to SP [73].

Management Role in Practice of Standard Precautions

Kingham *et al.* in their study of government and private hospitals in SearraLeone reported that only 20% of government owned hospitals had adequate sterile gloves and protective equipment. Suction pumps and aprons were available only in 30% - 40% respectively, while the mission and private hospital were fully stocked [74]. Cheng *et al.* studied 33 health service providers and 27 health administrators from difference provinces and reported poor attitude of administrator to SP, with some thinking that it was the responsibility of the health care giver not to get hurt. One administrator retorted that those involved probably did not wash their hand enough and that non compliance may be due to non acceptance of SPs, indicating proven lack of leadership [64]. Did-Barista *et al.* studied 100 hospitals in Italy and reported 97% and 98% of hospitals provided specific information and education initiative respectively. All introduced at least one needle stick prevention device with average 4 (1 - 11) centres implementing initiative to eliminate unnecessary needle injuries. All hospitals screened and vaccinated health workers against HBV [75]. Beckman *et al.* studied 153 of 240 hospitals in Iowa and Virginia on SP training and compliance and reported that 79% - 80% monitor nurses and laboratory technicians but physicians are rarely monitored or trained, most common measures to prevent NSIs was use of needle stick prevention devices. They noted that over 50% of hospital used needless intravenous systems with larger hospitals using more [35].

Grimond *et al.* in their national survey and estimation of sharp injuries in USA reported that effective reduction strategies observed in hospitals with low incidence sharp are intense and repeated competence training, monthly instruction email, easy incident reporting, management involvement, immediate action on trends and Zero incidence as goal [24].

4. Discussion

Needle stick injuries and exposure to patients' blood remain a risk for potential infection acquisition among health care workers and other medically exposed persons. The occurrence varied among different professionals and institutions in different countries but it remains a problem across the globe. Wicker *et al.* in their study of patient admitted into the University hospital in Germany reported that the prevalence of blood borne infection for HBV, HCV and HIV were 9 times, 15 times, 82 times respectively higher than in the general populace [35]. This review shows that there is clear and continued risk for blood borne pathogen transmission through needle stick and accidental exposure to patients' blood in both developed and developing countries. The prevalence varied depending on the population of healthcare workers or students studied. It ranged from 17% among HCWs in a tertiary hospital in India, [15] to 54% and 72.1% - 73% among nurses and midwifery students in Iran [16]. Most common activity that led to NSIs among nurses was recapping of needle especially double hand recapping.

Nurses have been identified as the main professional group that are most at

risk of needle stick injuries [20]-[27]. Surgeons though are at increased risk of NSIs but Physicians working in internal medicine department however are at most risk of contacting blood borne pathogen because greater number of their patients are infected with transmissible pathogens [37]. It is proper that preventive efforts target these groups, recapping should be strongly condemned and sharp containers made universally mandatory for disposable of sharp both in developed and developing countries. Incident reporting is essential components of NSI prevention not only for statistics but for post exposure prophylaxis. This is noted to be very low in most institutions in developing compared to developed countries [23] [30] [31]. Incident reporting should therefore be emphasised among other interventions for preventing needle stick injuries and exposure to patient's blood.

The safety of HCWs in their working environment necessitated the CDC to introduce a set of preventive measures that had metamorphosed from universal precaution to standard precaution as it is currently referred to. The knowledge of these measures among HCWs varied but in more recent literature was reported to be moderate to high across HCWs in both developing and developed nations. It is important to note that in some regions of some countries knowledge of SP still remain low [37]. Efforts are still needed in this regard. There appear to be a trend of increasing knowledge in South East region of Nigeria, comparing two studies 11 years apart that showed knowledge level raised from 50% to 76% [45] [46]. The practice or adherence to standard precautions however has remained low and lopsided and in some institutions poor [45] [48]. Some HCWs were found to be selective in their adherence to SP in the course of service delivery [60]. Most studies reported compliance rate of less than 60% and as low as 12% - 26% in some components of SP [2] [46] [47] [48]. The current efforts therefore should be directed at identified measurable interventions to improve practice and adherence to standard precautions.

Education remained one of the identified factors that increases knowledge and improves compliance to SP [68] [69]. Most of the studies reviewed concluded by recommending more training and education on standard precautions and their applications. A significant improvement in compliance to SP and remarkable reduction in needle stick injuries was reported following education and training [68]. Repeated and regular training was suggested by the finding by Obi *et al.* in Nigeria that reported strong association between the levels of education and how recently training was done [69]. Tesfay *et al.* reported that those that have been trained are 0.78 likely to be exposed to NSIs. There was also the need for the training to be supervised to produce required result [49]. McCoy *et al.* in their study in USA reported association between ICP assessed HCWs training and workers having sufficient information to comply with standard precautions and they also concluded that frequent education, leadership support are relevant in health workers training adequacy [73].

Poor infrastructures and inadequate supplies remain a major hindrance to

compliance to SP especially in developing countries. This was reported as the most common determinants of SP compliance in Nigeria, and has been reported as one of the negative predictor of adherence to standard precautions by other studies [62] [65]. Easily modifiable factors include lack of display of guideline for prevention of NSIs at points of health care services especially in area of high work demand, extended working hours, perception of HCWS of some patients being high or low risk, and that use of protective equipment interfere with the skill, increase job demand or pressure, comfortable working environment and room temperature and thinking that SP may not be needed when attending to paediatric cases. Methods that has been proven to be effective such as intense and repeated competence training, monthly instruction email, easy incident reporting, management involvement, immediate action on trends and Zero incidence as goal should be adopted.

In the surgical area the use of hand free techniques have been reported to reduce the risk of NSIs when blood loss is less than 100mls, this should be adopted by surgeons during operation and further researches conducted to improve on this. The disposition of health system administrators may be a strong factor in provision of requisite preventive equipment and compliance to SP. Public hospitals especially in developing countries are less likely to provide needed materials for effective NSIs prevention. Health care managers in developed countries appear more disposed to put in place measures and necessary equipment to enable HCWs comply to SP and ensure appropriate supervision. Such attitude and actions should be universal among health care administrators.

5. Conclusion

Percutaneous injuries and accidental exposure to patient's blood continues to pose infection transmission risks among HCWs in both developed and developing countries. Despite appreciable knowledge of standard precautions the practice has remained low across the globe. Adherence to standard precautions is negatively affected by unavailability of equipment and infrastructure especially in developing countries, Carelessness on the part of HCWs, lack of display of SP guideline at points of service deliveries, working under pressure and emergency nature of some care, poor attitude of HCWS to use of SP, poor knowledge, lack of training and management support were some of the identified factors that militate against adherence to SP. Factors that had positive influence on practice of SP such as use of devices with safety features, adherence to infection control guideline, comfortable working environment, repeated and intense training, hand free techniques during operations, monthly instruction emails, easy reporting of incidents to appropriate authorities, involvement of health system administrators, should be adopted and promoted.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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