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Factors Affecting Doctors' and Nurses' Compliance with Standard Precautions on All Areas of Hospital Settings Worldwide — A Meta-Analysis

R. (III) P. Dioso

Aim: This study analyses factors affecting SP compliance among doctors and nurses in all areas of hospital settings worldwide.

Methods: The PICO guide helped put focus on this meta-analysis. Of the 100 studies published from search engines and/or databases from 2009 to 2014, only four were selected. A PRISMA guideline was also used to eliminate other studies. Critique framework helped in analysing the studies selected.

Outcomes: Four significant factors affected doctors' and nurses' compliance with the practice of SPs – health threats, behaviour modifications, systems controls and educations, and health promotions. Of the 33 doctors in the Obstetrics and Gynaecologic department, 30% complied; of the 120 doctors – 60% interns, 34.2% residents and 5.8% consultants – complied by proper hand gloving (56.7%), hand hygiene (39.3%) and wearing aprons (58.3%); of the 32 hospital nurses, 100% complied; and of the 1,444 clinical nurses in the hospital, there is a $p<0.05$ (95%) that they all significantly complied. A total of 89.61% compliance was found among doctors and nurses from the four selected studies.

Key words: SP compliance; standard precaution among doctors and nurses; qualitative and quantitative meta-analysis

This meta-analysis aims to analyse worldwide factors significantly affecting doctors' and nurses' compliance with the practice of Standard Precaution (SP) to decrease infection rate on hospitals in a worldwide setting. Four studies are selected.

SP requires compliance of both doctors – including interns, consultants and residents - and nurses since they are partners in patient care (Wang 2002; Pittet 2001; Lam *et al*. 2011). If either of them does not comply with SP, the standard of patient care in all areas of hospital settings can be jeopardised (Choi & Choi 2010).

The purpose of this study is to identify strategies to reduced incidence of infections in all areas of hospital settings.

Concept

According to Nagliate *et al.* (2013), systems control on SPs for reducing the risk of transmission of blood borne and other pathogens in hospital settings that are health threatening was designed to help prevent contamination using hand hygiene, proper waste disposal, used of personal protective equipments, barriers and isolation techniques.

Siegel *et al*. (2007) earlier defined SP as a practice meant to prevent transmission of infectious agents among healthcare personnel through the use of suitable personal protective equipments *i.e.* are gowns, gloves, masks and eye shields and the practice of hand hygiene, appropriate handling of sharp instruments, proper waste disposal and the practice of environmental cleaning using isolation techniques – a behaviour modification approach.

The World Health Organisation (WHO) (2007/2009) has required that guidelines on SPs be included in the education and health promotion strategies by all hospitals worldwide for awareness of blood-borne transmitted pathogens and nosocomial infections i.e. HIV and Hepatitis. Hence, all health threatening microorganisms must also be considered when complying with hand hygiene according to the Center for Disease Control (CDC) (1996).

[1]Lincoln University College, Block A lot 1, Mayang Plaza, 1 Jalan SS 26/1, Taman Mayang Jaya, 47301 Petaling Jaya, Selangor, Malaysia
*Corresponding author (e-mail: duke@lincoln.edu.my)

Figure 1 illustrates the conceptual framework of this meta-analysis identifying health threats, behaviour modifications, systems control, educations and health promotions to be the factors affecting doctors' and nurses' compliance with SP.

BACKGROUND

SP had originated in 1987, replacing universal precaution introduced by the Centre for Disease Control and Prevention (CDCP), as an infection control practice. In 2007, the WHO based compliance with SPs by avoiding body fluids, blood, secretions and excretions (except sweat), mucous membranes and wound openings or non-intact skins because it may contain transmissible infectious microorganisms.

Six global regions conducted studies on the impact of complying with SPs in controlling healthcare acquired infection (HCAI) and their healthcare workers' (HCWs') compliance: Southeast Asian region (SEAR) (Kermode *et al.* 2005), The European region (EUR) (Efstathiou *et al.* 2011), the American region (AMR) (Garcia-Zapata *et al.* 2010), the Eastern Mediterranean region (EMR) (Askarian *et al*. 2004), the Western Pacific region (WPR) (Maharaj *et al*. 2012) and the African region (AFR) (Reda *et al*. 2010) highlighted on Table 1.

Choi and Choi (2010) conducted a study on high infection rates per day found among adults and paediatrics on intensive care units (ICUs). The International Nosocomial Infection Control Consortium (INICC) and National Nosocomial Infection Surveillance System (NNIS) validated this, saying that most patients infected in the ICUs are due to cather-related blood stream infection (CR-BSI), ventilator-associated pneumonia (VAP) and cather-related urinary tract infection (CR-UTI) (WHO 2009). Table 2 shows the overall infection rates/1000 device-days in ICUs of adults and paediatrics with CR-BSI, VAP and CR-UTI done by two surveillance networks – INICC and NNIS.

The PICO (Population, Intervention, Comparison and Outcome) guide helped in focusing the research questions: Do doctors and nurses comply with the practice of SPs affected by factors? The PICO are enumerated as:

- the population – nurses and doctors in all areas of hospital settings;
- the intervention – worldwide practice of SP;
- the comparison – results of four selected studies and the compliance result to SP; and
- the outcome – significant compliance and factors affecting the practice of SP among doctors and nurses in all areas of hospital settings worldwide.

METHODOLOGY

Search strategy starts with using keywords entered on search engines on internet as English text words. Boolean phrases with sign options such as (+) signs were used on text words. The databases are the Medline, British Nursing Index and CINAHL (Cumulative Index for Allied Health Literatures) that provided abstract and full text articles.

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guideline (Moher *et al.* 2009) helped eliminate other studies (Figure 2) – using inclusion and exclusion criteria.

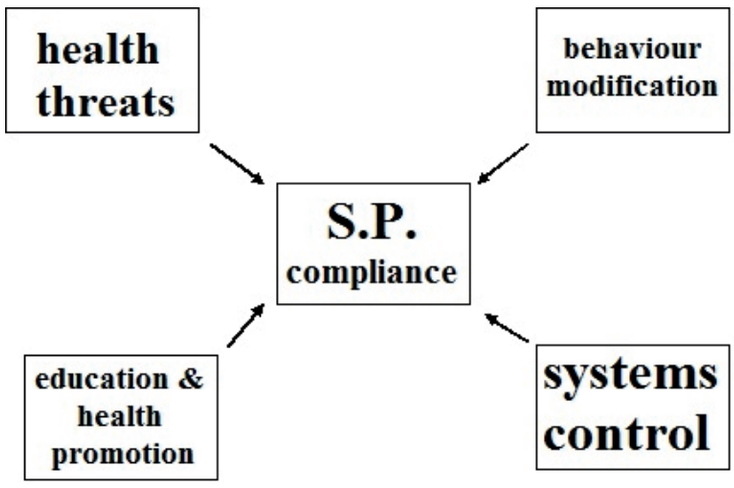

Figure 1. Cencept of the factors affecting SP compliance.

TABLE 1. COMPLIANCE TO SP ACCORDING TO REGIONS.

WHO region	No. of respondents	Compliance to SPs
AMR	237	52%
EUR	161	35%
SEAR and the WPR	42	9%
AFR and the EMR	17	4%
Country / region	Infection/organism	
India (EMR) and AFR	Human Immunodeficiency Virus	
United Kingdom (EUR)	Methicilline Resistant Staphylococcus Aureus	
USA (AMR)	Viral Septicaemia	
Australia (WPR)	Escherichia Coli	
AMR / AFR	Escherichia Coli	
United Kingdom (EUR) / AMR	Methicilline Resistant Staphylococcus Aureus	
AMR / SEAR	Viral Septicaemia	
AMR / SEAR	Staphylococcus Mercescens	
United Kingdom (EUR)	Clostridium Difficile	

Source: WHO 2009

TABLE 2. DEVICE-ASSOCIATED INFECTION RATES IN INTENSIVE CARE UNITS IN DEVELOPING COUNTRIES.

Surveillance network, study period	Setting	No. of patients	CR-BSI*	VAP*	CR-UTI*
INICC, 2003–2005	Paediatric ICU	1,529	16.1	10.6	5.3
NNIS, 2002–2004	Paediatric ICU	1,000	6.6	2.9	4.0
INICC, 2002–2005	Adult ICU	21,069	12.5	24.1	8.9

* Overall (pooled mean) infection rates/1000 device-days.
Source: WHO 2009

This study used both quantitative and qualitative paradigms. The study span included the year 2009 to 2014 - focussing on the PICO guide as the inclusion criteria. Studies that fell in the exclusion criteria were non-nurses and non-medical doctors, as well as compliance with SPs outside hospital settings. The critique framework of Caldwell *et al*. (2011) was used.

RESULTS

Of the 100 studies, only four were selected by process of elimination using the PRISMA guidelines (Figure 2). The summary of the selected studies is found on Table 3 with factors affecting compliance to SPs guided by the PICO.

Luo *et al*. (2010) investigated significant compliance with SPs by nurses affected by education and health promotion, with a probability value of (p) <0.05 as a result (95%). Among the 1,444 respondents on the questionnaire for "general self-efficacy scale, standard protective knowledge and of activities" using Cronbach's alpha and correlation regression signified 95% confidence interval that nurses comply with SPs. This means that only <5% of the 1,444 nurses did not comply with SP.

Luo *et al*. (2010) did a stratified random sampling from 18 hospitals in four districts in Hunan Province of China. Among these hospitals, four are first class, eight are second class and six are third class. Participants are qualified nurses with over 1 year working experience in a clinical department. The lowest SP compliance score obtained was the use of protective equipment such as eye shields, protective masks and quarantine clothes, while hand washing and sterilisation scored highest. The questionnaires used 10 questions with a single dimension scale with ranges 0 = never, 1 = seldom, 3 = usually and 4 = always (Askarian *et al*. 2007; Wang 2002; Schwarzer and Born 1997). The verification of results by the subjects, as well as the investigation board prior to publication and release, strengthened the credibility of this study.

Efstathiou *et al*. (2011), in another study, explored hospital nurses' shared experiences affected by behaviour on compliance with the practice of SPs (100%) using a focus group. This study covered 32 registered nurses in

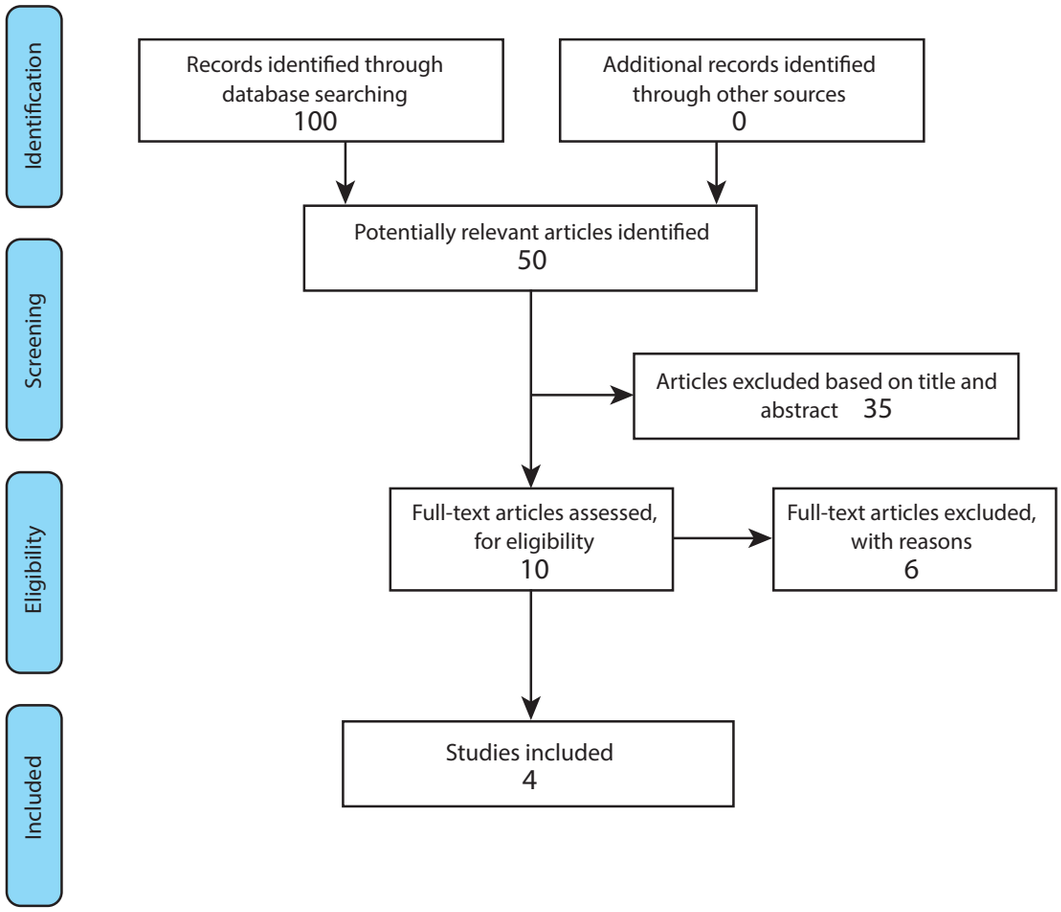

Figure 1. PRISMA guideline (Moher et al. 2009).

TABLE 3. SUMMARY OF THE FOUR SELECTED STUDIES GUIDED BY THE PICO.

Comparison	Intervention	Population (n)	Outcome
Maharaj *et al*. 2012	Determine SP Compliance	Doctors in the hospital n= 33	SP compliance: 30.3 % Factor: Health threat
Efstathiou *et al*. 2011	Explore SP Compliance	Hospital nurses n= 32	SP compliance: 100% Factor: Behaviour modification
Luo *et al*. 2010	Investigate SP Compliance	Clinical nurses in the hospital n= 1444	SP compliance: 95% Factors: Education and health promotion
Jawaid *et al*. 2009	Discover SP Compliance	Doctors in the hospital n=120 • Interns 60% • Residents 34.2% • Consultants 5.8% • Proper hand gloving 56.7% • Hand hygiene 39.3% • Wearing aprons 58.3%	SP compliance: Factor: Systems control Doctors' compliance: 81.7% Nurses' compliance: 97.5% Overall compliance: 89.61%

government-owned hospital in Cyprus where all medical specialties are offered.

Efstathiou *et al*. (2011) used purposive sampling from as many different clinical nursing disciplines as possible. This study's criteria for inclusions were the subjects' willingness to participate; they must have two years of working experiences; and a testimony of their active provision of care to patients and hospital workplaces. The same study ensured credibility by using a principal investigator during discussions to check and monitor if the interview were structured and verified if interviewees (the nurses) had a lot of hospital trainings before they conduct the interview.

On the other hand, doctors comply with SPs affected by systems control as a factor, according to a cross sectional study that was done by Jawaid *et al*. (2009) that randomised 120 participants working in Karachi's tertiary care teaching hospital. The aim to establish suboptimal compliance failed as 52.5% did not know anything about the CDCP (1987) guideline on SPs while 40% of the respondents had some idea and only 75% knew SP well. This means that the system of orienting the 52.5% subjects to the guidelines of CDCP were a failure and the 25% of the 75% who had lesser idea of SP must be properly oriented to comply with SPs. The data results were interpreted by SPSS analysis version 10. The results were checked and counter-checked, establishing the credibility of this study. The questionnaires were also the same instruments used in Dow University of Health Sciences in Pakistan for a study done by Clement *et al*. (2002).

Lastly, Maharaj *et al*. (2012) made a study among 33 doctors randomly selected from two hospitals in New Zealand. The objective was to determine awareness of compliance with SPs by medical staff in Obstetrics and Gynecologic Units. Among the respondents, 30% gave a significant compliance to SP affected by health threats by using goggles (63.6%), wearing gloves (97.0%) and using aprons (75.8%). An anonymous self-administered questionnaire was given to these doctors and its retained result data were analysed using Microsoft office excel garnering a 95% confidence interval result ($p<0.05$) as reported. Among the 33 doctors in the gynecology department, those who use full precautions were categorised as consultants (35.7%), registrars (33.3%), seniour medical officers (33.3%) and house surgeons (0.0%). This means that <70% of the 33 doctors perceived themselves as non-compliance to the practice of SPs. Just like the previous studies, Maharaj *et al*. (2012) was also validated, therefore, credible. However, it is also necessary to enumerate the components of the identified factors affecting compliance with SPs.

Maharaj *et al*. (2012) found two components of health threats as factors affecting SP compliance. The first component of health threat is the mucocutaneous exposure or exposure to body fluids such as eye splashes with mucous secretions and contact with vaginal secretions. According to Kelen *et al*. (1990) and Evanoff *et al*. (1999) this kind of health threat will always be encountered on emergency departments where open wounds are found.

The second component of health threat is the droplet contamination. Beekmann *et al*. (2001) agreed that transmission of infectious microorganisms through body fluids as droplets coming in contact in the conjunctiva is a health threat since hepatitis and human immunodeficiency viruses are transmitted through these routes.

The CDC (1996), on the other hand, facilitated education and health promotion to ensure a decrease incidence of hospital acquired infection among HCWs as a health threat. According to Luo *et al*. (2010), the first component of education and health promotion needed to make nurses comply with SPs are constant trainings and provisions of continuous seminars – especially if these trainings become a compulsory requirement to nursing staff in hospitals. Second is the hospital grading system that considers patient satisfaction from the nursing service provided – in order to achieve an indicated grade (Luo *et al*. 2010). The third component is the general self-efficacy affecting personal behaviours as nurses and doctors efficiently comply with SPs. Fourth component specific to health promotion is the availability of sharp disposals addressing resource allocation done by hospital managements. Another component is called the exposure experience, *i.e*. when nurses experience to get sick because of a hospital acquired infection that results to learning by experience. Lastly, provisions of sufficient equipments are components of health promotion in all areas of hospital settings to comply with the practice of SPs (Luo *et al*. 2010).

In contrast, Efstathiou *et al*. (2011) had found five components of behaviour modification as factors affecting the practice of compliance with SPs among nurses. Components are the self efficacy affected by behaviour, the severity of fear, serious disease-death and negative impact on life; the costs from being infected; the cues to act during intervention; the 'benefit' for psychological and physiological protection against infection; 'susceptibility' as risks and vulnerabilities of nurses to infection; and the barriers during emergency situations that interferes with the care being delivered to patients/clients.

Lastly, Jawaid *et al*. (2009) also listed five components of systems control: availability of equipments (58.3%), time availability (14.2%), ability to remember to comply (15.0%), practicality (20%) and an inadequate knowledge to the techniques of isolation and proper waste disposal (7.5%).

Ethical issues

Complying with SPs must be done autonomously by doctors and nurses in all areas of hospital settings worldwide (Lymer *et al*. 1997; CDCP, 1987). Awareness on SP compliance will benefit patients on all areas of hospital settings.

This meta-analysis used four significant studies found on search engines that address the four factors affecting compliance with the practice of SP. The biases on selecting the studies used random sequence and allocation concealment as a form of selection bias. This justifies the benefit of awareness on how to practice SP that outweighs the harm of selection bias.

DISCUSSION

Selecting research studies published on internet search engines mostly have positive results, and researchers must be aware that these are examples of selection biases, since most studies are not published on the internet with negative results.

The four selected studies spanned from four different countries to justify that diversities among subjects – nurses and doctors – as the most valued partnership in hospital settings who must comply with the practice of SPs.

Nurses and doctors must work hand-in-hand in hospital settings to reduce the incidence of the spread of infection in hospitals by complying with SPs (Lymer *et al*. 1997; Chan *et al*. 2002; Lam *et al*. 2011). Education, public health awareness of health threats, behavior modification and systems control are implied as factors to make doctors and nurses autonomously comply with the practice of SP.

Implications to practice

Primarily, educating newly hired employed hospital nurses and medical doctors to the CDCP (1987) guidelines should be implied to practice since this can be an influential factor affecting compliance to SPs. Hospital management should also educate all doctors and nurses to actively promote the practice SPs.

Bauer and Kenney (1993) and Danchaivijtr *et al*. (1997) said that it is also implied on hospital management not to misuse systems control resulting in selective practice of SPs, which could also be a reason for an insufficient and inappropriate SP application, technique and usage. This misused systems control pertains to the insufficient and selective allocation of resources.

To further explain, nurses and doctors belonging to lower class hospitals will definitely be disadvantaged because they are still deemed to use recycled personal protective equipments because of misused systems control (Luo *et al*. 2010). It is then implied to practice that personal protective equipments as an expensive means of practicing SP must be recycled for handling waste materials and not for patient/client care in order to budget hospital financial constraints (Siegel *et al*. 2007). In addition to the provisions and availability of resources, the equipments must not deteriorate to limit interference with patient and/or client care (Maharaj *et al*. 2012; Luo *et al*. 2010).

The use of personal protective equipments is most likely to be practiced appropriately by most HCWs (86.6%) (Bauer and Kenney, 1993), unlike reports of non-compliance with the use of personal protective equipments is followed by only 40–60% of nurses in a study done by Heenan (1992). Hand hygiene is the best option if gloves are not available although gloving is still important (CDC, 1996; CDCP, 1987).

It is incumbent upon hospital managers to provide with a readily accessible alcohol-based hand rub product and pocket sized gloves in entrances of the wards and isolation areas of hospitals (Saghafi *et al*. 1992). The location at the entrance to the patient's room or at the bedside will make it easier for all hospital staff to practice proper hand hygiene and use of gloves (Saghafi *et al*. 1992) – a modification of behaviour leading to compliance with the practice of SPs.

On the other hand, in a fast paced environment, SPs are difficult to practice (Talan and Baraff, 1990; DeJoy *et al*. 2000). It is also implied that the hospital management must anticipate a fast paced provision of gowns, sterile gloves and goggles that are pocket-sized and that are readily available for doctors and nurses so that it can be immediately used (DeJoy *et al*. 2000; Talan and Baraff, 1990).

Proper waste disposal is implied in the obstetrics and gynecologic departments according to Maharaj *et al*. (2012) since patients' mucous membranes are usually exposed in this specific hospital setting.

Compliance with isolation technique according to Larson (1983) addresses barriers in patient care by isolating highly infected patients with airborne diseases. This form of SP is affected by factors such as susceptibility and vulnerability to infections that are health threatening according to Efstathiou *et al*. (2011) making doctors and nurses comply. This is also implied to pediatrics and neonatal settings in the hospitals.

Hand hygiene is specifically implied to be practiced in operating theaters/departments (DeJoy *et al*. 2000; Larson, 1983) as a health threat. Doctors and Nurses must be aware

of health threatening microorganisms by washing hands surgically to protect themselves from patients/clients or vice versa (WHO 2009; Gershon *et al*. 1995/1994).

Lastly, WHO (2009) says that doctors and nurses are to be aware of the implications of waterborne pathogens in water supplies. Doctors in all areas of hospital settings must emphasise on washing hands with antiseptic soaps because water supplies can also be infected with pathogens, which regular soap and water could not destroy (Streiner and Norman, 2003; Ransdell, 1996).

Table 4.0 enumerates health threatening microorganisms and how the SP guidelines of 2007 can be used for systems control, behaviour modification and education and health promotion.

TABLE 4. FACTORS INTEGRATED WITH SP GUIDELINES IMPLIED TO PRACTICE.

Health threatening microorganisms (WHO, 2009)	Systems control	Education and health promotion	Behaviour modification
Bacteria			
Campylobacter jejuni, C. coli	Environmental cleaning	Hand hygiene	Waste disposal
Pathogenic Escherichia coli	Waste disposal	Hand hygiene	Gloving and Facial protection
Enterohaemorrhagic E. coli	Equipment care	Hand hygiene	Gloving and Facial protection
Legionella spp.	Waste disposal	Gloving and Facial protection	Equipment care
Tuberculosis mycobacteria	Respiratory hygiene	Gloving and Facial protection	Equipment and linen care
Pseudomonas aeruginosa	Hand hygiene	Respiratory hygiene	Equipment care and gloving
Salmonellaes	Gloving	Hand hygiene	Equipment and linen care
Shigella spp.	Gloving and Facial protection	Waste disposal	Hand Hygiene
Vibrio cholerae	Gloving and Facial protection	Waste disposal	Hand Hygiene
Burkholderia pseudomallei	Gloving and Facial protection	Waste disposal	Hand Hygiene
Yersinia enterocolitica	Gloving and Facial protection	Waste disposal	Hand Hygiene
Viruses			
Adenoviruses	Environmental cleaning	Hand hygiene	Respiratory hygiene
Enteroviruses	Waste disposal	Hand hygiene	Respiratory hygiene
Hepatitis-As	Equipment care	Gloving and Hand hygiene	Prevent needle stick
Hepatitis-Bs	Waste disposal	Gloving and Hand hygiene	Prevent needle stick
Noroviruses and sapoviruses	Waste disposal	Hand hygiene	Respiratory hygiene
Retroviruses	Facial Protection	Prevent needle stick	Linens and Waste disposal
Protozoa			
Acanthamoeba spp.	Waste disposal	Environmental cleaning	Gloves and Hand hygiene
Cryptosporidium parvum	Waste disposal	Waste disposal	Gloves and Hand hygiene
Cyclospora cayetanensis	Waste disposal	Equipment care	Environmental cleaning
Entamoeba histolytica	Waste disposal	Gloves and Hand hygiene	Environmental cleaning
Giardia lamblia	Waste disposal	Equipment care and linens	Gloves and Hand hygiene
Naegleria fowleri	Waste disposal	Equipment care and linens	Gloves and Hand hygiene
Toxoplasma gondii	Waste disposal	Equipment care and linens	Gloves and Hand hygiene
Helminths			
Dracunculus medinensis	Environmental cleaning	Hand hygiene	Linens
Schistosoma spp.	Environmental cleaning	Hand hygiene	Facial Protection

Source: WHO, 2007

CONCLUSION

It is therefore concluded that doctors and nurses comply with the practice of SPs in all areas of hospital settings (89.61%). However, there are four significant factors affecting doctors' and nurses' compliance with SPs:

- Health threats
- Behaviour modification
- Education
- Systems control

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