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3 **Factors associated with the compliance of standard precaution;**  
4 **review article**

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10  
11 **Abstract**

12 Compliance with standard precautions is very important for healthcare workers  
13 because studies have shown that it helps in minimising the transmission of  
14 infectious diseases and healthcare-associated infections which is directly  
15 proportional to the patient cost and stay of the patient in hospitals. As healthcare  
16 associated infections increase, the cost and the stay of the patient will increase.  
17 Researchers suggest that all healthcare workers need to follow the standard  
18 precautions guideline and it can be possible with the help of health education,  
19 training, provision of equipment and supervision by the management. Barriers to  
20 the compliance identified are lack of education, heavy workload, unavailability  
21 of equipment, lack of resources and lack of access to supplies. The lack of  
22 education and heavy workload are the major factors faced by the nurses.

23 **Key Words:** Healthcare workers, Universal precautions, Standard precautions.

24  
25 **Introduction**

26 Standard precautions (SPs) are helpful in preventing the transmission of  
27 infections and reducing the rate of healthcare associated infections (HCAIs)  
28 which will ultimately reduce the cost of the patients and hospital stay. In

29 healthcare settings, registered nurses and doctors play important roles in policy-  
30 making and implementation for infection control. The current review was planned  
31 to assess literature in this area.

32

### 33 **Search strategy**

34 Search engines Pub-Med, Science Direct and Google Scholar were used to  
35 retrieve relevant articles. The key words used for the search were “Knowledge  
36 and Practice of SPs among healthcare workers”, “Universal Precautions among  
37 healthcare workers”, “Factors affecting the compliance of Standard Precautions”  
38 and “Barriers to compliance of Standard Precautions”. The search resulted in  
39 70,300 articles. After applying time filter from 2009 to 2019, the search narrowed  
40 down to 881(1.25%) articles. This was further shortlisted based on the title,  
41 availability of the article, English language, and availability of abstract. Finally,  
42 51(5.8%) articles were selected for the current review, and 22(43%) of them were  
43 found to be eligible for in-depth review.

44

### 45 **Definition and components of SPs**

46 According to the studies shortlisted, the increasing spread of HACIs has made it  
47 extremely important for healthcare workers (HCWs) to practise SPs, which, in  
48 short, include wearing personal protective equipment (PPE), taking care to  
49 protect themselves while handling all types of patients, including contact  
50 precautions and airborne precautions, taking specific care when treating high-risk  
51 individuals, increasing awareness about personal hygiene amongst patients,  
52 proper disposal of waste, safe injection practices as well as the procedure in case  
53 of needle-prick injury and ensuring not only the availability of the required  
54 equipment and hospital infrastructure, but also regularly monitoring the  
55 compliance of HCWs with SP guideline. Moreover, the studies have used the  
56 definition of the Centres for Disease Control and Prevention (CDC)<sup>1-14</sup> (Table).

57

**58 SP guidelines**

59 The CDC is working on SPs to reduce the rate of HCAs all over the world  
60 because HCAs are the infections patients get with the treatment from HCWs,  
61 which is a major problem, but is also preventable with the help of SP practices.  
62 SPs guidelines control the rate of infection in healthcare settings to reduce the  
63 risk of blood-borne and other pathogens as well as it can also reduce the rate of  
64 HCAs. It had also been analysed that among the males needle-stick injury  
65 reporting was significantly higher than the female ( $p < 0.01$ ) and the staff nurses  
66 were more compliant with SPs compared to nursing students ( $p < 0.001$ ) (5, 15).  
67 As per CDC guideline, all HCWs need to assume that all the patients are possibly  
68 infected or can transmit infections in a healthcare setting. Therefore, the HCWs  
69 need to apply the SPs while attending all the patients either infected or not. For  
70 compliance with SPs, all HCWs need proper hand hygiene, use of PPEs, such as  
71 gloves, gown, mask, face and eye shield, according to the risk assessment and  
72 predicted contact, such as respiratory hygiene and cough etiquette, needle-stick  
73 injury prevention, medical equipment handling, proper disposal of waste and  
74 sharp objects, environmental cleaning and proper transport and processing of the  
75 linen used by patients (16). A pre- and post-test interventional study in 2018  
76 analysed significance difference post-test. In pre-test, more than half of the  
77 participants (57%) showed inadequate knowledge, while in the post-test, only 2%  
78 reported inadequate knowledge and low compliance to SPs. Therefore, the study  
79 recommended making online infection control programme mandatory for all  
80 HCWs (11). One of the elements of SPs includes hand hygiene and the statement  
81 is supported by CDC that HCWs clean their hands less than 50% of the time they  
82 need to. WHO and CDC recommended using alcohol-based hand rubs (ABHRs)  
83 for hand hygiene because of its effectiveness against broad-spectrum  
84 microorganisms, being less time-consuming and it can be kept at patient's bed-  
85 side which can be easily accessible (17). Another study reported that patient's  
86 hand hygiene decreased clostridium difficile events which were occurring most

87 frequently before initiating patient hand hygiene. The study reported significant  
88 results post-intervention (8). PPE use is the second element of SPs and refers to  
89 the use of gloves, gown, mask, face and eye shield. A study in Jordan reported  
90 that 90% of the nurses had good knowledge about the SPs, but they have limited  
91 knowledge based on specific isolation precautions in which only 42.2% had  
92 correct knowledge regarding the contact isolation, and 40.7% had correct  
93 knowledge about the air-borne isolation. In this study, they also identified some  
94 factors leading to non-compliance of SPs including lack of supplies,  
95 organisational factors and heavy workload. The study recommended more health  
96 education programmes, proper monitoring and supervision of infection-control  
97 practices (3). The CDC mentioned that respiratory hygiene and cough etiquettes  
98 are also the part of SP guideline in which they mentioned that every personnel  
99 needed to cover his/her mouth and nose with a tissue paper while coughing or  
100 sneezing, and the person who is coughing/sneezing needs to sit 3 feet away from  
101 other people, if possible. The CDC also recommended that HCWs should wear  
102 surgical mask when assessing patients with droplets or any respiratory infection  
103 (13).

104 According to CDC, safe injection is the part of SPs because unsafe injection is  
105 risky for both patients and HCWs. The CDC stated that unsafe practice could lead  
106 to multiple HCAIs. Numbers reported from different part of the united States  
107 included 18 cases of hepatitis C infections associated with a surgical technician  
108 at a Colorado hospital in 2009, 25 cases of gram-negative bacteraemia associated  
109 with a nurse at a Minnesota hospital, 25 cases of hepatitis C infections associated  
110 with radiology technician reported from New Hampshire, Kansas and Maryland  
111 in 2012. (12). According to CDC, a heating, ventilation and air conditioning  
112 (HVAC) system is a basic and essential system needed in all healthcare settings  
113 to remove contaminated air, maintain the temperature and humidity at the  
114 patient's comfort level, and to minimise the risk of microorganism spreading  
115 from infected patients. An HVAC includes air inlet or intake from outside, its

116 filtration and humidity modification accordingly, heating and cooling equipment,  
117 and grilles for air distribution. Decreased performance of HVAC system in a  
118 healthcare facility can contribute to HCAs (16). According to CDC guideline,  
119 all reusable equipment or devices must be cleaned or sterilised as per instructions  
120 to prevent the transmission of infections(16). One study on infections related to  
121 medical devices reported ventilator-associated pneumonia (VAP) rates high in  
122 both medical and surgical intensive care unit (ICU). The range of VAP in 5  
123 groups was analysed. In groups 1-4 it ranged from 0.9 to 51.6 per 1000, while  
124 one group had VAP rate of 186.5 per 1000(18). Another study showed there were  
125 one-third ICU infections which could have been prevented by adopting the  
126 recommended preventive measures. The study mentioned that HCWs needed  
127 more precautions other than the SPs that are isolated precautions, such as droplet,  
128 contact and air-borne precautions. It also mentioned another strategy for  
129 preventing water-borne infections that entailed boiling the water before use,  
130 regular cleaning and regular maintenance of the water-tank (19).

131 A hospital setup needs to properly dispose of the waste because hospital waste  
132 can cause various diseases in the community. A 2016 study in India showed that  
133 due to exposure with certain waste, various health problems were recognised such  
134 as diarrhoea, malaria, skin and respiratory infections. (20).

135

### 136 **Knowledge and Practice of SPs for Reducing HCAs**

137 A study conducted in China reported that only half of the nurses had received  
138 training and had knowledge regarding SPs, while the remaining half had not even  
139 heard about the word “SPs”. The study indicated that knowledge was positively  
140 correlated with the compliance of SPs ( $r=0.24$ ) which suggested that greater  
141 knowledge would lead to better SP compliance. Another factor identified in the  
142 study was that the nurses who had received training on SPs had greater  
143 compliance with SPs than those who had not received training (4). An  
144 experimental study in China compared two groups with the usage of hand rub

145 disinfectant. The possible analysis of the explanation for the low compliance with  
146 hand hygiene was lack of knowledge regarding the use of hand hygiene and its  
147 effect on their health, insufficient equipment that is unavailability, less resources,  
148 skin irritation, and damage to skin with the use of the disinfectant. It  
149 recommended that for reducing HCAs, the HCWs need to be more compliant  
150 with SPs. It will only be possible with the help of regular skill-based training,  
151 continuing education session, and frequent monitoring of the HCWs following  
152 the SP guidelines (6). A pre-post interventional study, done to check the impact  
153 of an infection control programme on nurses, reported that the knowledge  
154 regarding SPs before the infection control programme was 51.2% while post-  
155 intervention it was 87.2%. The study found that education regarding infection  
156 control improved knowledge regarding SPs. Thus, more infection control training  
157 programmes were needed for reducing the HCAs with the help of improvement  
158 in the knowledge regarding SPs and to reduce the cost of the patients due to  
159 increased stay of the patient diagnosed with HCAs (10). Moreover, a study  
160 observed that the practice of SPs relied on overall hospital quality. It revealed that  
161 the ease and availability of PPE had an important role in compliance with SPs. It  
162 observed that HCWs from a small hospital were not good in practising SPs, and  
163 mentioned some other reasons that included lack of infrastructure, and the  
164 absence of an infection control department (2). The study also suggested that SPs  
165 should be followed for every patient, and not for specific patients, such as those  
166 with human immunodeficiency virus (HIV) or acquired immunodeficiency  
167 syndrome (AIDS), because it created social stigma for the patients and their  
168 families. SPs are more important than isolation precautions, because no one  
169 knows the patient diagnosis without any laboratory investigations. Therefore, it  
170 is important to follow SPs and take every patient as infected (2).

171 Overall, the studies reviewed have shown that HCWs have a lack of knowledge  
172 regarding SPs and that is why the practice of SPs is not up to the mark which

173 can be improved with proper training. However, there are multiple factors  
174 affecting SP compliance.(21).

### 175 **Factors affecting SP compliance**

176 Multiple factors can affect the practice of SPs, such as knowledge, training,  
177 refresher course, supervision by the management, ongoing education session and  
178 working environment. SPs are important elements for infection control, and every  
179 organisation has its own policy regarding infection control, but the studies cited  
180 above have shown high rates of HCAs. The factors associated with low level of  
181 knowledge and practices are many more. Some of them are interpersonal, others  
182 are departmental, while some of them are organisational. Studies have stated that  
183 more than 80% of the HCWs did not receive previously any educational session  
184 on SPs and that more than 80% wanted to be trained regarding SPs (7). Another  
185 study with a large sample in France identified some factors which needed to be  
186 improved for enhancing the compliance with SPs, like promoting use of gloves  
187 use while having blood contact risk, use of PPE, changing gloves and hand  
188 hygiene as well as avoiding recapping of the needle (1). One qualitative study  
189 using in-depth interviews of nurses in Uganda explored the low compliance with  
190 SPs(22). During the interviews most of the participants commented that they tried  
191 their best to practise SPs based on their knowledge, but the reason behind low  
192 compliance was lack of resources unable to fulfil the demand, policy issues and  
193 patient overflow. However, the nurses also shared their strategies for preventing  
194 infections which were departmental and personal approach. They suggested that  
195 the units needed to be designed to avoid congestion for minimising the risk of  
196 infection to HCWs and cross-infection among patients. Another suggestion was  
197 for adequate ventilation which can compensate for the overflow of the patients.  
198 The study also showed that the nurses working in resource-limited settings had  
199 difficulties in practising SPs owing to limited resources, maintenance issues for  
200 inadequate ventilation, lack of information and overcrowding. For such a setting,  
201 the nurses frequently balanced the available resources to minimise risk to patients

202 and themselves. The study showed that the nurses were over-burdened and had  
203 limited resources. To overcome these challenges the nurses demonstrated their  
204 resilience and decided to practice SPs on isolation-based precaution (22).

205 However, studies have suggested that treating the patient on the basis of their  
206 disease, which is isolation-based precaution, is an ethical issue because HCWs  
207 shall treat all patients equally by practising SPs to avoid stigmatisation of certain  
208 patients. Moreover, it has also been recommended that provision of safe,  
209 respectful and non-discriminatory care is essential with the help of practising SPs  
210 to reduce the labelling of a patient with specific infectious disease, which is very  
211 important for reducing the stigmatisation (14, 21).

212

### 213 **Conclusion**

214 As reviewed, literature indicates that primary HCWs, comprising doctors and  
215 registered nurses, are less sensitive regarding the SP compliance. Therefore, it is  
216 necessary for them to be encouraged by the management to follow SP guidelines  
217 which is only possible through health education, training and provision of  
218 facilities. However, hospital managements also need to take care of associated  
219 factors that might be responsible for Sp non-compliance, like heavy workload,  
220 lack of education and training, unavailability of PPE, lack of resources and  
221 supplies etc.

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226

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318 **Table: The definition and components of Standard Precautions (SPs)**

ARTICLE	DEFINITION OF STANDARD PRECAUTIONS	COMPONENTS OF STANDARD PRECAUTION
Compliance with standard precautions: Results of a French national audit(1)	The Centers for Disease Control and Prevention (CDC) is a federal agency that conducts and supports health promotion, prevention, and preparedness activities in the United States with the goal of improving overall public health.	<ol style="list-style-type: none"> <li>1. Wearing and changing gloves while providing bedside care to the patients and between the patient care activities, appropriate needle recapping and hand-detaching soiled needles, taking care of hygiene (hand washing with hydrochloric acid, liquid soaps and disinfectants, cleaning hands with sanitizer, etc.).</li> <li>2. Using a single-use mask and goggles in the event of risk for blood or body fluid splattering/vaporizing, and appropriate way to of waste disposal.</li> </ol>
Factors affecting performance of hospital control infection in Japan (2)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Availability of sufficient well trained full time Infection Control(IC) staff, development and maintenance of hospital infrastructure (such as proper ventilation system, Air conditioners, keeping check of temperature and humidity level etc.).</li> </ol>
Knowledge and practices of isolation precautions among nurses in Jordan(3)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Hand hygiene reinforced before and after handling the patient and reinforced the use of gloves, gown and isolated room for contact precautions patient and proper waste disposal which mentioned that the waste of the patient having air borne infection should be disposed of in red container or bag separated from other waste.</li> <li>2. Gowns and goggles should be worn for the procedures and activities which have chances of splashes and sprays of blood or body fluids.</li> <li>3. Nurses who have a respiratory infection are advised to avoid direct patient contact or wear a surgical mask, especially with high-risk patients.</li> <li>4. Patients with airborne precautions are preferred to be in negative-pressure isolation rooms.</li> </ol>
Factors impacting compliance with standard precautions in nursing, China(4)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Use of protection equipment such as eye shields, protective masks, and quarantine clothes while practicing hand washing and sterilization. Presence of a sharps disposal box in the department is important.</li> </ol>

Validity and reliability assessment of the Compliance with Standard Precautions Scale Arabic version in Saudi nursing students(5)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. SPs include performance of hand hygiene using personal protective equipment (PPE), such as gloves, gowns, masks, face eye shields, goggles, apron and guided risk assessment manuals. Including recapping needle technique, sharp disposal and water proof wound dressing. Moreover, all these equipment should be discarded in red bag after use.</li> </ol>
Experimental study on disinfection effect of different dose of rapid hand disinfectant(6)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Using good handwashing methods (using effective antiseptics, quick drying hand disinfectants etc.).</li> <li>2. The six step hand washing method described in the "Standard for hand hygiene for healthcare workers in healthcare settings" should be strictly administered.</li> </ol>
Knowledge, Practice, and Attitude Among Iranian Nurses, Midwives, and Students Regarding Standard Isolation Precautions(7)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Availability of personal protective equipment and its correct use (such as gloves, gown, goggles, disposal of medical waste, and effective needle disposal systems).</li> </ol>
Can improving patient hand hygiene impact Clostridium difficile infection events at an academic medical center?(8)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. hand hygiene and personal health hygiene of the patient was considered to be very important for: Prior to meals, after using the toilet or bedpan, prior to touching dressings and incisions, after returning from testing or a procedure, before and after having visitors).</li> <li>2. Availability of bedside pre-packaged alcohol wipes, soap and hand hygiene facility (using wet and dry paper towels etc.).</li> </ol>
Clean Hands Count for Healthcare Providers(9)	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Use of alcohol based hand sanitizer immediately before touching a patient, before performing an aseptic task (e.g., placing an indwelling device) or handling invasive medical devices, and after contact with blood, body fluids or contaminated surfaces.</li> <li>2. Wash with soap and water when hands are visibly soiled, and after known or suspected exposure to spores (e.g. <i>B. anthracis</i>, <i>C difficile</i> outbreaks). Wear gloves when contact with blood or other potentially infectious materials could occur, change gloves between two patients and perform hand hygiene during patient care.</li> </ol>
Impact of an infection-control program on nurses?	The definition will be same as above.	<ol style="list-style-type: none"> <li>1. Environmental control, hand hygiene, universal precautions such as personal protective equipment (PPE), decontamination of patient care</li> </ol>

knowledge and attitude in pediatric intensive care units at Cairo University hospitals(10)		<p>equipment, specimen handling, personal hygiene and appropriate disposal of syringes, needles and sharps etc.</p> <p>2. Nurses should avoid recapping syringes and should empty a sharp box only when half-full. When exposed to accidental needle-stick injury (NSI) they should wash the injured site with water and soap and take the post-exposure prophylaxis.</p>
Improving knowledge and compliance with infection control Standard Precautions among undergraduate nursing students in Jordan(11)	The definition will be same as above.	<p>1. Nurses should also maintain hand hygiene by washing hands.</p> <p>2. Availability of online curriculum for infection control.</p> <p>3. Compliance with the use of personal protective equipment, disposal of sharp objects and other biological wastes, decontamination of spills and used articles, and prevention of cross-infection is also essential.</p> <p>4. Availability of resources such as masks, gloves, sinks, water, and paper hand towels.</p>
Injection Safety(12)	The definition will be same as above.	<p>1. Proper use of syringes, needles, and medication vials during routine healthcare procedures, such as administering injections.</p>
Respiratory Hygiene/Cough Etiquette in Healthcare Settings(13)	The definition will be same as above.	<p>1. All individuals having respiratory infection should take care of cough etiquette and should dispose off the tissue after use, and should perform hand hygiene.</p> <p>2. Nurses should wear a surgical or procedure mask when examining such patients.</p>
The ethical and pedagogical effects of modelling “not-so-universal” precautions(14)	The definition will be same as above.	<p>1. Use universal precautions when exposed to other patients’ blood and other bodily fluids. Wear goggles and change gloves after every patients and change gloves between two patients.</p>

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