

Factors Associated with Compliance with Infection Control Guidelines in the Management of Labour by Healthcare Workers at Mulago Hospital, Uganda

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Abstract

Globally, infections acquired during childbirth contribute to one tenth of the maternal deaths annually [1] [2]. Factors predisposing to high risks of puerperal infections include non-compliance with Standard Precautions of Infection Control (SPIC), unhygienic births by unskilled birth attendants, multiple vaginal examinations, prolonged labour and premature rupture of membranes [1]. The main purpose of this study was to determine factors associated with compliance to standard precautions of infection control the management of labour by healthcare workers in Mulago Hospital to generate information, which may be used in infection control and prevention practices. A cross-sectional study utilizing a quantitative approach was conducted among 115 healthcare workers. Consecutive sampling was done to include respondents in the study. Data were collected by direct observation and researcher administered questionnaires. Data were coded and entered into the computer using SPSS version 20 with programmed quality control checks. Descriptive data analyses, frequencies, cross tabulations and logistic regression analysis were the major statistical methods used. 103 healthcare workers were involved in the study, where 74% were females. Overall compliance was at 52%, although it varied across domains. The majority of the healthcare workers (95.1%) did not comply with hand hygiene. Being a male was associated with low compliance scores a cross most domains. One of the hospital factors which was significantly associated with compliance to hand hygiene was having had an in-service training with $p = 0.008$ and $p = 0.012$ at multivariate analysis. Overall compliance to standard precautions of infection control was

low compared to the Centre for Disease Control (CDC) recommendation. The findings in this study provide insight into individual and hospital related factors associated with compliance with standard precautions of infection control in the management of labour. There is an urgent need to put up interventions to improve on compliance with SPIC in management of labour among all healthcare workers.

Keywords

Compliance, Standard Precautions of Infection Control, Labour, Healthcare Workers

1. Introduction

Standard Precautions of Infection Control (SPIC) protocols replaced Universal Precautions and were formulated to be used in the care of all patients regardless of their diagnosis [3] [4]. According to WHO (2016), SPIC include: hand hygiene, use of Personal Protective Equipment (PPE), observing aseptic non-touch technique, disinfection and sterilization of reusable equipment and clothing used during patient care, environmental control (e.g., surface cleaning), health service waste handling, appropriate waste segregation of sharps, waste segregation excluding sharps, and isolation of patient's in accordance to requirement levels as an infection transmission source.

Compliance with SPIC in the management of labour by all healthcare workers in all health care facilities and other health service centres is very crucial in preventing maternal peripartum infections [3] [5]. The WHO (2016) highly recommends practice of asepsis in six areas also known "the six cleans" which include clean delivery surface, clean hands of the birth attendant, clean perineum of the mother, clean cord cutting instrument, clean cord ligature and clean cord care. In spite of the long period since the introduction of the SPIC, full compliance is still a matter of concern in many healthcare facilities [6].

Globally, infections acquired during childbirth process contribute to one tenth of the maternal deaths annually [1] [2]. These infections are one of the leading causes of maternal mortality and morbidity, with sepsis accounting for as much as 15% of the 289,000 maternal lives lost globally every year [7] [8].

Factors predisposing to high risks of puerperal infections include non-compliance with SPIC, unhygienic births by unskilled birth attendants, multiple vaginal examinations, prolonged labour and premature rupture of foetal membranes home [1]. Other factors also include the flora of the delivery room, and the types of antibiotics used, [9].

The situation is worse in developing countries where resources for healthcare delivery are limited [10]. Sub-Saharan Africa contributes three quarters of the global estimate for maternal sepsis related deaths [1] [11]. If death does not occur, these infections have been identified as a leading cause of maternal morbid-

ity, prolonged hospital stay, chronic disability, chronic pelvic pain and secondary infertility [12].

In Uganda, the second leading cause of maternal mortality after haemorrhage is sepsis, where the mortality rate stands at 14% (UDHS, 2016). Many hospitals reports have indicated a big number of mothers admitted in the hospital receiving care during labour and childbirth, develop puerperal sepsis [11]. Evidence has suggested that all deaths as a result of sepsis are preventable through hygienic practices and delivery environments and these have been historically well documented [13]. Healthcare workers have been identified to be in a key position in the prevention of hospital acquired infections [7] [14].

Non-compliance with standard precautions of infection on the side of healthcare workers has been linked to lack of adequate training in infection control protocols, lack of supplies in the healthcare facilities and work overload [15]. Other studies have suggested that lack of appropriate knowledge of SPIC, lack of Personal Protective Equipment (PPE), low-risk perception and low perception of institutional safety environment are frequent factors linked to non-compliance to SPIC (Gammon *et al.*, 2008).

The WHO highly recommends compliance with the standard precautions of infections control during management of labour by all healthcare workers. Compliance with standard precautions on the part of Healthcare Workers (HCWs) has been emphasized as fundamental and efficient means of healthcare-associated infections for both patients and healthcare workers [16].

Mortality rate in Uganda due to sepsis has overwhelmingly increased to almost double from 8% and 14% between four years (UDHS, 2016; UDHS, 2012). A recent study done in Mbarara regional referral and teaching hospital indicated that puerperal sepsis accounted for 30.9% of maternal deaths [11]. Yet healthcare workers are in a key position to preventing healthcare acquired infections [14]. This could be due to differences in professional background, inadequate training in SPIC, availability of standard operating procedures and work overload [15].

The existing evidence about the health care practitioners, infection control practices in the management of labour does not provide an in-depth insight about compliance with standard precautions of infection control.

In search for literature, there is paucity of data about this topic in maternity services although some studies have generally looked at general practices of SPIC in different areas of healthcare practice. Therefore, this study describes factors associated with compliance to standard precautions of infection control in the management of labour by healthcare workers at Mulago Hospital.

2. Methods

2.1. Study Design

This study utilized a descriptive cross sectional design of quantitative approaches, where the data from a population or a representative of subset is analyzed at

specific point of time and the investigator measures the outcome and the exposure in the study participants at the same time (Gordis, 2009). Cross sectional study design is cheap and yet good at estimating the prevalence of the problem because data on the cause and outcome are collected at the same time [17]. This design was used because it is reliable at estimating the magnitude (compliance) and determinants of the phenomenon.

2.2. Study Site

The study was carried out in Mulago National Referral hospital, department of Obstetrics and Gynecology located in Kawempe Division, approximately 5km from Kampala city center. It is the National Referral Hospital for the country and it handles all issues concerning women's health including prenatal care, postnatal, immunization, family planning, oncology and gynecology. The hospital conducts approximately 80 deliveries per day, 2400 deliveries per month and 28,800 deliveries per year (HMIS, 2017).

The clinical services delivered in this department (labour suite) per month are offered by HCWs of different professional cadres, which include 73 midwives, 19 obstetricians 42 Senior House Officers (SHO's), and 28 medical interns (total 163). This makes a total of 163 HCWs who work in labour suites as per monthly duty roster (Hospital, 2017). There are two units in this department that deal with deliveries these include, low risk labour suite, high-risk labour suite. The mothers after delivery are transferred to post-natal unit and of these, a bigger proportion develop puerperal sepsis (HMIS, 2017).

2.3. Study Population

The study population comprised of HCWs (midwives, nurse midwives, intern nurses and midwives, senior house officers, obstetricians) who are 163 in total as per monthly duty roster (Hospital labour suite, statistics) at Mulago hospital working in the department of obstetrics and gynecology in labour suite units.

2.4. Inclusion Criteria

The study included HCWs (Nurses, midwives, intern nurses, nurse/midwives, intern doctors, obstetricians and senior house officers) who are involved in the management of labour.

2.5. Exclusion Criteria

The study excluded healthcare workers who are sick, those on leave and those busy with administrative work.

2.6. Sampling Procedure

The study utilized non probability quota sampling proportionate to size using convenience sampling. A fair representation of all cadres was considered by selecting a participant from all cadres to be included in the study. The first res-

pondent was picked on as she/he commences on her shift. No respondent declined in participating in the study if they met the inclusion criterion until the desired sample size was achieved.

2.7. Sample Size Determination

The number of study subjects was estimated using Kish & Leslie (1969) formula for homogeneous population who are in single study group with proportion outcome variable.

$$N = \frac{z^2 pq}{d^2}$$

where:

N = the required sample size.

z = the z score corresponding to 95% confidence level (1.96).

p = proportion complying with standard precautions of infection control among healthcare workers in Kenya.

$q = 1 - p$ (the expected proportion of the study population who do not comply with standard precautions for infection control).

d = degree of precision in the study.

This formula was used to calculate N for this study, basing on the following evidence from studies carried out before.

The confidence level of the researcher in this study was at 95% (Hence $z = 1.96$).

Compliance among healthcare workers in Tanzania stands at 49.7% [18].

Hence $p = 0.497$, the proportion, $q (1 - p)$ will be $1 - 0.497 = 0.503$ hence $q = 0.503$ in this study.

The degree of precision in the study was estimated at 5% (Hence $d = 0.05$).

Substituting in the above formula, therefore:

$$N = \frac{1.96^2 \times 0.497 \times 0.503}{0.05^2} = 384$$

Since the sample, size was higher than the number of the healthcare workers who are on a monthly roster of the two labour suites of Mulago hospital

The required sample size was calculated using a formula for infinite populations. Considering the finite population correction factor;

$$n = \frac{n_0 \cdot N}{n_0 + (N - 1)}$$

where n = required sample size, $n_0 = 384$ and $N = 163$, therefore by substituting in the above formula, the required sample size $n = 163$ respondents

$$N = \frac{384 \times 163}{384 + (163 - 1)} = 115$$

Hence, the sample size was 115 participants

For representativeness, Probability Proportionate to Size (PPS) was considered.

Cadres	Calculations by sample size
Midwives 70	$\frac{70}{163} \times 115 = 49$
Obstetricians 19	$\frac{19}{163} \times 115 = 13$
Senior house officers 37	$\frac{37}{163} \times 115 = 26$
Medical interns 28	$\frac{28}{163} \times 115 = 27$
TOTAL = 163	TOTAL = 115

2.8. Definition and Measurement of Variables

2.8.1. Dependent Variables

The primary outcome was compliance with Standard precautions of infection control in management of labour. This was measured as a categorical variable using an observation checklist modified from observation checklist for CDC (2008) and a modification from the validated observation checklist [5].

Assessment of compliance was by participant direct observation based on indication and corresponding action. An indication refers to a situation in which an infection prevention and control practice must be undertaken to prevent the risk of a pathogen being transmitted from one surface to another (see [Appendix I](#)). Actions occur in response to indications, such that each indication has a corresponding action.

Compliance means that the correct action has been taken. For example, for the domain of hand hygiene ([Table 1](#) of the observation checklist), the indication “Before touching the patient” indicates the possibility that physical contact could lead to microbial transmission. The correct action corresponding to this indication is “Health-care worker washed his or her hands with soap and water or used an alcohol-based hand rub).

2.8.2. Independent Variables

Independent variables associated with compliance to SPIC include: socio-demographics variables include gender and professional category, qualification, cadre, work these were measured using a questionnaire (see [Appendix II](#)).

2.9. Data Collection Methods

This was a non-intrusive as the healthcare workers were left to do what they usually do while practicing infection control and prevention measures in labour suite unless there is a life-threatening event that forces the observer to intervene. If this happened, then that case would be dropped, but this never happened throughout the study. During the direct observation by the principal investigator created a rapport with the study participant to pave a way to ask the few questions which are in the questionnaire indirectly in a manner that the respondent never considered this an observation of their practices. The observed data was

entered on the checklist immediately to avoid recall bias. This method was adopted from a study which was done in Nigeria [1].

Every day, at least 2 healthcare workers study participants were observed and interviewed. Data were collected between February and April 2018.

One respondent was observed at a time throughout the three procedures. The four main procedures considered included; physical examination, vaginal examinations, invasive procedures and conducting delivery. The six infection control and prevention domains were observed across these procedures. The domains have been identified as crucial for the safety of patients and HCWs by WHO, CDC and the Ugandan Ministry of Health and these are:

- 1) Hand hygiene;
- 2) Use of personal protective equipment;
- 3) Disinfection of reusable equipment and cleaning of delivery surfaces
- 4) Waste segregation of sharps
- 5) Waste segregation excluding sharps and,
- 6) The non-touch technique.

For each of these domains, compliance with Standard Precautions of Infection control (SPIC) as practiced by the healthcare workers. Each domain was scored as either “Yes” for complied or “No “not complied after the respondent has scored all. The direct observation was done without the knowledge of the study participants in order to avoid change of behavior in their SPIC practices.

2.10. Data Collection Procedure

Administrative clearance from Mulago hospital institutional review board was sought. Institutional consent was obtained from the unit managers to minimize on the change of behavior. Healthcare workers were identified by use of a duty roster before a shift. Since the study was unobtrusive (covert) direct observation, deferred consent was sought after the study where the principal investigator debriefed the participants about the study and the findings and asked them whether they would allow their findings be used for data analysis. In addition, those who objected this their findings were not included for data analysis.

2.11. Data Collection Tools

An observation checklist was modified from CDC (2008) infection control assessment tool and a validated observation checklist of a study, which was done in Kenya, to assess compliance by practices of the HCWs on SPIC [5].

A pilot study of 10 HCWs was conducted at Naguru Regional Referral Hospital labour ward, which has similar characteristics as the study area to test the tool for validity and reliability.

2.12. Quality Control Measures

The Principal Investigator collected data in order to avoid bias by other researchers and directly observed the performance of HCWs to avoid change of

behavior of HCWs during performing of routine procedures.

The questionnaire was pretested before data collection on 10 HCWs from Naguru hospital since it has similar characteristics of being also a referral facility as Mulago national referral hospital.

To improve validity/reliability of data collection on observational studies, the principal investigator through participative observation offered an assistive role to the healthcare worker performing the procedure. Interviews were conducted alongside the participative by the principal investigator. This was adopted as strategy to minimize the Wharthone's effect.

Quality of data collected was ensured by cross checking completeness of the data checklist and the questionnaire, which was used to assess the individual and facility factors. The principal investigator also crosschecked all filled data collection tools at the end of each data collection shift.

2.13. Data Management and Analysis

Data collected was entered, cleaned and analyzed using SPSS version 20 to generate descriptive statistics.

Overall compliance and non-compliance was calculated by adding up all percentages from each domain then divided by the total number of domains which was 6 this method was obtained from different studies which were conducted on compliance with infection control practices [5].

A binary score of yes (performed) and no (not performed) were used for the six domains of SPIC.

In addition, to generate descriptive statistics, categorical variables were described in form of frequencies, percentages and texts.

For objective one, data was analyzed to yield percentages of compliance of respondents and was be presented in form of a table and pie chart.

The objective two and three data were analyzed by chi square test/cross tabulation to yield frequencies, percentages and *p*-values for each SPIC domain. This method was utilized because the some of the data had no values hence this would not yield the Odds Ratios (OR) and Confidence Intervals (CI).

2.14. Ethical Considerations

Approval to do the study was sought from the School of Health Sciences Research and Ethics Committee/institutional review board (SHREC:REF: 2017:057.) An administrative clearance was obtained from Mulago Hospital research and ethics committee. The approval letters from the School of Health Sciences REC and administrative clearance from Mulago hospital were presented to the clinical head of and of obstetrics and gynecology of Mulago national referral hospital.

Differed consent was sought after the study where the principal investigator debriefed the participants about the study and the findings and asked them whether they would allow their findings be used for data analysis. Those who objected this their findings were not included for data analysis.

3. Results

Social Demographic Characteristics/Individual Factors of the Respondents

The study involved 115 but only data for 103 respondents who offered differed consent were analyzed. Majority of the participants were females (74%). Most of the respondents were midwives (44%) and almost a half of the respondents (48%) were bachelor's degree holders as a level of academic qualification. Half of the study participants (51%) worked in other health facilities/multiple places. Other characteristics are presented in **Table 1** below.

In **Table 2**, majority (84%) of the healthcare workers had not seen the standard operating procedures (SOPs) at the facility. Moreover, majority (65%) had not had an in-service training on SPIC.

Table 3, shows proportions of compliance with SPIC by health care workers in management of labour in the six domains which are hand hygiene, personal protective equipment, equipment processing and surfaces, waste segregation of sharps, waste segregation excluding sharps and the non-touch technique. Study results show that the majority (95.1%) of the HCWs did not comply with hand hygiene compared to other domains of SPIC in the management of labour. However, the observation tool captured that majority (94.2%) of the HCWs complied with use of PPE and 77.7% complied with waste segregation of sharps.

Table 1. Social Demographic Characteristics/individual factors of the respondents.

Characteristics	Frequency (<i>n</i> = 103)	Percentage (%)
Gender		
Male	27	26
Female	76	74
Professional cadre		
Midwife	45	44
Obstetrician	34	33
Medical Intern	24	23
Qualification level		
Master's degree	11	11
Bachelor's degree	49	47
Diploma & Certificate	43	42
Work experience (in years)		
2 - 4	13	13
5 - 10	39	38
>10	29	28
Work in other facilities		
Yes	53	51
No	50	49

Table 2. Characteristics of the hospital factors.

Characteristics	Frequency (<i>n</i> = 103)	Percentage (%)
Seen any SOPs of infection control/prevention		
Yes	17	17
No	86	84
Had in-service training on SPIC		
Yes	65	63
No	38	37

Proportions of compliance with standard precautions of infection control in management of labour by healthcare workers.

Table 3. Level of compliance with standard precautions of infection control in the management of labour by healthcare workers.

Variables	Frequency	% (95% Confidence Interval)
Hand hygiene		
Compliance	5	4.9 (2 - 11)
Non compliance	98	95.1 (89 - 98)
Use Personal Protecting Equipment		
Compliance	97	94.2 (88 - 97)
Non compliance	6	5.8 (3 - 12)
Equipment processing of non-re-usable equipment & cleaning delivery surfaces		
Compliance	26	25.2 (18 - 34)
Non compliance	77	74.8 (66 - 82)
Waste segregation of sharps		
Compliance	80	77.7 (69 - 85)
Non compliance	23	22.3 (15 - 31)
Waste segregation excluding sharps		
Compliance	62	60.2 (51 - 69)
Non compliance	41	39.8 (31 - 49)
Non touch technique		
Compliance	52	50.6 (41 - 60)
Non compliance	51	49.4 (40 - 59)

Univariate Analysis

Univariate was the primary analysis and the variables associated with the outcome. To obtain proportions of compliance and the *p*-values were also obtained from the chi-square for each domain. Compliance and the associated factors were presented in tables mentioned below. This method was utilized to calculate for frequencies, percentages and *p*-values. This method was preferred because majority of the data had zero values and hence could not be run in logistic re-

gression to obtain odds ratios and confidence intervals. **Table 4** below indicates hand hygiene and use of personal protective equipment.

Individual factors associated with standard precautions of infection control in management of labour among healthcare workers at univariate analysis.

Table 4 below indicate that females complied with hand hygiene compared to the males who did not comply at all, while the bachelor's holders (100%) were likely to comply than other levels of qualification. Results also indicate that work in different places was statistically associated with compliance to hand hygiene (p -value 0.018). In the same **Table 4** below results indicate that majority of the females (73%) used Personal Protecting Equipment (PPE).

In **Table 5**, results indicate majority of the females complied to equipment processing compared to their male counterparts and gender was significantly

Table 4. Individual factors associated with hand hygiene.

Variables	Hand hygiene Compliance		p -value	Use of PPE Compliance		p -value
	Yes $n = 5$ (%)	No $n = 98$ (%)		Yes $n = 97$ (%)	No $n = 6$ (%)	
Gender						
Male	0 (0)	27 (28)	0.172	24 (25)	3 (50)	0.172
Female	5 (100)	71 (72)		73 (75)	3 (50)	
Professional cadre						
Midwife	1 (20)	44 (45)	0.137	45 (46)	0 (00)	0.073
Obstetrician	1 (20)	33 (34)		30 (31)	4 (67)	
Medical intern	3 (60)	21 (21)		2 (23)	2 (33)	
Qualification level						
Bachelor's Degree	5 (100)	44 (45)	0.055	44 (45)	5 (83)	0.101
Master's Degree	0 (00)	11 (11)		10 (10)	1 (17)	
Diploma and Certificate	0 (00)	43 (44)		43 (44)	0 (00)	
Work experience (in years)						
≤1	2 (40)	20 (20)	0.648	20 (21)	2 (33)	0.839
2 - 4	1 (20)	12 (12)		12 (12)	1 (17)	
5 - 10	1 (20)	38 (39)		37 (38)	2 (33)	
>10	1 (20)	28 (29)		28 (29)	1 (17)	
Work in multiple facilities						
Yes	0 (0)	53 (54)	0.018*	49 (51)	4 (67)	0.442
No	5 (100)	45 (56)		48 (49)	2 (33)	

p -values obtained from chi-square test/cross tabulation to indicate the frequencies, percentages and p -values. *indicates significant findings because the p -value is <0.05.

Table 5. Individual factors associated with disinfection of re-usable equipment, and waste segregation of sharps.

Variables	Disinfection of re-usable equipment & cleaning delivery surfaces, Compliance		<i>p</i> -value	Waste segregation of sharps Compliance		<i>p</i> -value
	Yes <i>n</i> = 26 (%)	No <i>n</i> = 77 (%)		Yes <i>n</i> = 80 (%)	No <i>n</i> = 23 (%)	
Gender						
Male	3 (12)	24 (31)	0.049*	18 (23)	9 (39)	0.110
Female	23 (88)	53 (69)		62 (77)	14 (61)	
Professional cadre						
Midwife	15 (58)	30 (39)	0.241	36 (45)	9 (39)	0.046*
Obstetrician	6 (23)	28 (36)		22 (28)	12 (52)	
Medical intern	5 (19)	19 (25)		22 (28)	2 (9)	
Qualification level						
Bachelor's Degree	15 (58)	30 (39)	0.241	36 (45)	9 (39)	0.046*
Master's Degree	6 (23)	28 (36)		22 (28)	12 (52)	
Diploma and Certificate	5 (19)	19 (25)		22 (28)	2 (9)	
Work experience (in yrs.)						
≤1	4 (15)	18 (23)	0.705	18 (23)	4 (17)	0.148
2 - 4	4 (15)	9 (12)		8 (10)	5 (22)	
5 - 10	9 (35)	30 (39)		28 (35)	11 (48)	
>10	9 (35)	20 (26)		26 (32)	3 (13)	
Work in multiple facilities						
Yes	13 (50)	40 (52)	0.864	40 (50)	13 (57)	0.581
No	13 (50)	37 (48)		40 (50)	10 (43)	

p-values obtained from chi-square test/cross tabulation to indicate the frequencies, percentages and *p*-values. *indicates significant findings because the *p*-value is <0.05.

associated with compliance to equipment processing (*p*-value 0.049). In the same **Table 5**, it is indicated that majority of the people who complied with waste segregation of sharps were females (62%). Professional cadre and level of qualification were also statistically associated with this same domain (*p*-values 0.046 and 0.046) respectively.

Table 6, results show that most females (60%) complied to waste segregation of sharps and it is also indicated that gender was statistically associated with compliance with this same domain of SPIC (*p*-value < 0.000). It is also indicated that the majority in the professional cadre who complied were midwives (44%). the same variable, professional cadre and level of qualification were statistically associated with compliance to waste of sharps (*p*-values < 0.00 and <0.001

Table 6. Individual factors associated with waste segregation excluding sharps and observing aseptic non-touch technique.

Variables	Waste segregation excluding sharps Compliance		<i>p</i> -value	Aseptic Non-Touch technique Compliance		<i>p</i> -value
	Yes <i>n</i> = 62 (%)	No <i>n</i> = 41 (%)		Yes <i>n</i> = 52 (%)	No <i>n</i> = 51 (%)	
Gender						
Male	2 (3)	25 (61)	<0.000*	16 (31)	11 (22)	0.288
Female	60 (97)	16 (39)		36 (69)	40 (78)	
Professional cadre						
Midwife	44 (71)	1 (2)	<0.000*	15 (29)	30 (59)	0.007*
Obstetrician	2 (2)	32 (78)		23 (44)	11 (21)	
Medical intern	16 (26)	8 (20)		14 (27)	10 (20)	
Qualification level						
Bachelor's Degree	20 (32)	29 (71)	<0.001*	28 (54)	21 (41)	0.009*
Master's Degree	0 (00)	11 (27)		9 (17)	2 (4)	
Diploma and Certificate	42 (68)	1 (2)		15 (29)	28 (55)	
Work experience (in yrs.)						
≤1	12 (19)	10 (24)	0.422	12 (23)	10 (20)	0.169
2 - 4	10 (16)	3 (6)		4 (8)	9 (18)	
5 - 10	21 (34)	18 (46)		24 (46)	15 (29)	
>10	19 (31)	10 (24)		12 (23)	17 (33)	
Work in multiple facilities						
Yes	23 (37)	30 (73)	<0.000*	28 (54)	25 (49)	0.624
No	39 (63)	11 (27)		24 (46)	26 (51)	

p-values obtained from chi-square test/cross tabulation to indicate the frequencies, percentages and *p*-values. *indicates significant findings because the *p*-value is <0.05.

respectively). In the same **Table 6** results indicated, that and observing the non-touch technique was statistically associated with professional cadre and level of qualification with *p*-values of 0.007 and 0.009 respectively.

Table 7 shows the Hospital/Facility related factors associated with standard precaution of infection control in management of labour among healthcare workers. It is indicated that having had an in-service training was significantly associated with complying to hand hygiene (*p* = 0.018).

Table 8 results show the factors associated with hospital factors and compliance with disinfection of re-usable equipment and waste segregation of sharps. The results show that majority of the non-compliance with disinfection of re-usable equipment (84%) of the HCWs had not seen SOPs, while 69% had not received an in-service training on SPIC.

Table 7. Hospital/facility factors associated with Hand hygiene technique and use of Personal protecting equipment.

Variables	Hand hygiene Compliance		P-value	Use of PPE Compliance		p-value
	Yes (n = 5)	No (n = 98)		Yes (n = 97)	No (n = 6)	
Seen any SOPs of infection control/prevention						
Yes	0 (0)	17 (17)	0.308	17 (18)	0 (0)	0.262
No	5 (100)	81 (83)		80 (82)	6 (100)	
Had in-service training SOPs						
Yes	4 (80)	29 (30)	0.018*	30 (31)	3 (50)	0.331
No	1 (20)	69 (70)		67 (69)	3 (50)	

p-values obtained from chi-square test/cross tabulation to indicate the frequencies, percentages and p-values. *indicates significant findings because the p-value is < 0.05.

Table 8. Hospital/facility factors associated with disinfection of re-usable equipment and cleaning of delivery surfaces and waste segregation of sharps.

Variables	Disinfection of re-usable & cleaning delivery surfaces compliance		P-value	waste segregation of sharps Compliance		p-value
	Yes n = 26 (%)	No n = 77 (%)		Yes, n = 80 (%)	No, n = 23 (%)	
Seen any SOPs of infection control/prevention						
Yes	5 (19)	12 (16)	0.665	14 (18)	3 (13)	0.612
No	21 (81)	65 (84)		66 (82)	20 (87)	
Had in-service training SOPs						
Yes	9 (35)	24 (31)	0.745	24 (30)	9 (39)	0.408
No	17 (65)	53 (69)		56 (70)	14 (61)	

p-values obtained from chi-square test.

In **Table 9**, results show that majority of the people (74%) who complied with waste segregation excluding sharps had had an inservice training.

Bivariate Analysis

Individual factors associated with compliance to standard precautions of infection control in management of labour among healthcare workers at bivariate analysis was done for those variables that had numbers that can be computed to get the odds ratios and confidence intervals and aggregated results are shown in **Table 10**.

The results indicated in **Table 10**, show that those who have had a work

Table 9. Hospital/facility factors associated with waste segregation excluding sharps and aseptic Non-Touch Technique.

Variables	waste segregation excluding sharps Compliance		<i>P</i> -value	Aseptic Non-Touch Technique Compliance		<i>p</i> -value
	Yes <i>n</i> = 62(%)	No <i>n</i> = 41(%)		Yes <i>n</i> = 52(%)	No <i>n</i> = 51(%)	
Seen any SOPs of infection control/prevention						
Yes	12 (19)	5 (12)	0.338	6 (12)	11 (22)	0.170
No	50 (81)	36 (88)		46 (88)	40 (78)	
Had in-service training SOPs						
Yes	16 (26)	17 (41)	0.096	18 (35)	15 (29)	0.571
No	46 (74)	24 (59)		34 (65)	36 (71)	
No	1 (2)	5 (12)		3 (6)	3 (6)	

p-values obtained from chi-square test.

Table 10. Individual factors associated with compliance to SPIC at bivariate analysis.

Variables	Hand Hygiene		Use of PPE		Disinfection of re-usable equipment and cleaning of delivery surfaces	
	OR 95% CI	<i>P</i> -value	OR 95% CI	<i>P</i> -value	OR 95% CI	<i>P</i> -value
Gender						
Male	1.00		1.00		1.00	
Female	1.00	0.172	0.33 (0.06 - 1.17)	0.190	0.29 (0.07 - 1.05)	0.060
Work experience in years						
<1	1.00		2.8 (0.24 - 33.04)	0.414	2.03 (0.53 - 7.73)	0.302
2 - 4	1.2 (0.10, 14.69)	0.887	2.33 (0.13 - 40.46)	0.561	1.01 (0.25 - 4.17)	0.986
5 - 10	3.8 (0.32, 44.51)	0.288	1.51 (0.13 - 17.54)	0.740	1.50 (0.51 - 4.43)	0.463
>10	2.8 (0.24, 33.04)	0.414	1.00		1.00	

p-values and odds ratios obtained from logistic regression.

experience of 5 years and below were two times more likely to comply with hand hygiene and disinfection of re-usable equipment than those with more than five years work experience.

In **Table 11**, indicate results from cross tabulation for waste segregation of sharps, waste segregation excluding sharps and observing the non-touch technique. Results show that profession cadre was associated with waste segregation of sharps statistically significant with *p*-values < 0.029 for obstetricians. It is also indicated in **Table 11** that work experience of 2 - 4 years was also significantly associated (*p*-value 0.043) with waste segregation of sharps. Gender was significantly associated with compliance to waste segregation excluding sharps (*p*-value

< 0.001). In the same table, professional cadre was significantly associated with compliance with waste segregation p -value 0.005 for midwives and p -value < 0.001 for obstetricians. Results also indicate that professional cadre (midwife) was statistically associated with observing the non-touch technique with a p -value of 0.048.

Table 12 below results reveal that having seen Standard Operating Procedures (SOPs), was two times more likely to comply with observing the non-touch technique that those who had not.

Multivariate Analysis

Multivariate analysis was carried out to control for confounders using only

Table 11. Individual factors associated with compliance with SPIC in bivariate analysis.

Variables	Waste segregation of sharps		Waste segregation excluding sharps		Aseptic Non-touch technique	
	OR 95% CI	P -value	OR 95% CI	P -Value	OR 95% CI	p -value
Gender						
Male	1.00		1.00		1.00	
Female	0.45 (0.17 - 1.1)	0.115	0.02 (0.00 - 0.10)	<0.001*	1.62 (0.66 - 3.94)	0.290
Professional cadre						
Midwife	2.75 (0.54 - 13.91)	0.221	0.05 (0.01 - 0.39)	0.005*	2.8 (1.01 - 7.77)	0.048*
Obstetrician	6 (1.20 - 30.0)	0.029*	32 (6.07 - 168.57)	<0.001*	0.67 (0.23 - 1.98)	0.468
Medical Intern	1.00		1.00		1.00	
Work experience in years						
<1	1.93 (0.38, 9.66)	0.426	1.58 (0.51, 4.93)	0.428	0.59 (0.19 - 1.80)	0.352
2 - 4	5.42 (1.05, 27.81)	0.043*	0.57 (0.13, 2.56)	0.463	1.59 (0.40 - 6.38)	0.514
5 - 10	3.40 (0.85, 13.58)	0.083	1.63 (0.60, 4.39)	0.335	0.44 (0.17 - 1.18)	0.102
>10	1.00		1.00		1.00	

p -values and odds ratios obtained from logistic regression. *indicates significant findings because the p -value <0.05.

Table 12. Hospital/facility factors associated with SPIC in the management of labour by healthcare workers at bivariate analysis.

Variables	Waste segregation of sharps		Waste segregation excluding sharps		Aseptic Non-touch technique	
	OR 95% CI	p -value	OR 95% CI	p -value	OR 95% CI	p -value
Seen any SOPs of infection control						
Yes	0.71 (0.18 - 2.71)	0.613	0.58 (0.19 - 1.78)	0.342	2.11 (0.72 - 6.22)	0.176
No	1.00		1.00		1.00	
Had in-service training in SPIC						
Yes	1.5 (0.57 - 3.93)	0.410	2.04 (0.88 - 4.73)	0.098	0.79 (0.34 - 1.81)	0.572
No	1.00		1.00		1.00	

Odds ratios and p -values obtained from logistic regression. *indicates significant findings because the p -value <0.05.

the independent variables that had shown significant relationship with the outcome variable in bivariate analysis. A few factors were analyzed at once and by removing one and adding another factor such that the same factors are not analyzed together. Results are presented in **Table 13** below. Results in **Table 13** below indicate that, having had an in-service training was statistically associated with compliance to hand hygiene.

Table 14 below indicates results obtained from multivariate analysis of the association of waste segregation excluding sharps. Results show that being a female was statistically significant with waste segregation excluding sharps ($p = 0.000$).

4. Discussion

4.1. Individual Factors Associated with Compliance to Standard Precautions of Infection Control in Management of Labour by Healthcare Workers

The social demographic characteristics in this study were also regarded as individual factors. Data from 103 study participants were analysed. Results indicate

Table 13. Multivariate analysis of the association of Hand hygiene technique.

Variables	Odds ratio	95% C.I	<i>p</i> -value*
Work experience (in years)			
≤1	1.14	(0.05 - 24.96)	0.932
2 - 4	7.41	(0.23 - 237.72)	0.258
5 - 10	7.00	(0.10 - 472.57)	0.365
>10	1.00		
Had in-service training on SPIC			
Yes	0.04	(0.003 - 0.49)	0.012*
No	1.00		

p-values obtained from a logistic regression. *indicates significant findings because the *p*-value < 0.05.

Table 14. Multivariate analysis of the association of waste segregation excluding sharps.

Variables	Odds ratio	95% C.I	<i>p</i> -value*
Gender			
Male	1.00		
Female	0.015	(0.00 - 0.08)	0.001*
Seen any SOPs of infection control/prevention			
Yes	0.212	(0.04 - 1.24)	0.086
No	1.00		
Had in-service training on SPIC			
Yes	3.869	(0.97 - 15.36)	0.054
No	1.00		

p-values obtained from a logistic regression*indicates significant findings because the *p*-value < 0.05.

that the majority of the study participants were females at 74%, this could have been due to the fact that majority according to professional cadre were midwives (48%). According to the Ugandan training system in midwifery education, entry requirements suggest that one should be a female in order to be enrolled in the training program. According to Kopolu *et al.* (2005), females are seen to be more in the clinical practice of the healthcare system and the males in administrative and policy levels.

This study demonstrated that compliance with standard precautions of infection control was generally highly associated with the above mentioned. Although the overall score was low, obstetricians in all the domains of SPIC had lower scores compared to other professional cadres for example in the hand hygiene domain where 100% of this cadre did not comply. This could have been as a result of work overload as it is indicated in Uganda the doctor patient ratio currently stands at 1:25,725 (UDHS, 2016).

It was found that majority of the medical intern (60%) were more compliant with hand hygiene compared to other professional cadres. The findings in this study were also congruent with those a study done in Jordan [19] which found out that nurses had significant higher compliance than physicians with mean = 4.91 ($p = 0.004$).

In our study, females scored higher than males in overall compliance with a statistically significance difference. This was in agreement with a study done in Jordan about factors influencing compliance with infection control precautions among 211 nurses and physicians from private and public hospitals, it was indicated that there was a significant positive correlation between compliance and individual factors such as gender where being a female was likely to be associated with compliance to SPIC. The female HCWs' compliance with SPIC might be due to the natural proneness of female employee to obey and execute institutional rules and regulations [10]. Moreover, in Uganda women take a major role in cleaning, cooking and caretaking this could make them cautious about infection control and prevention to their family. of their family Females are usually seen performing duties that require cleanliness as part of their gender roles.

In this study work experience of 2 - 4 years was significantly (p value 0.043) associated with compliance with waste segregation of sharps. This is in contrast with pertinent studies where having more experience in clinical services was found to be significantly associated with compliance. For instance a study done in India [20] which indicated length of time was statistically significant with compliance ($p = 0.014$) where those who had longer stay on job had better compliance. Our study findings of a short work experience could be related to the fact that these healthcare workers are fresh graduates and inspired in applying knowledge into skills, this could also be explained by the Bloom's taxonomy of the learning domains, where the higher the level of learning, the more the learners will tend to apply more of the psychomotor domain.

Results in this study, indicated that work in multiple places influenced compliance with hand hygiene and segregation of waste excluding sharps negatively. It was apparent that respondents working in multiple places showed lower compliance scores compared to those who did not. Work overload has also been found to influence stress and hence decrease competence among healthcare workers [21]. This could be due to the fact that, Mulago as a national referral hospital, receives an overwhelmingly huge numbers of mothers in labour yet there is inadequate staffing. In Uganda currently the doctor-patient ratio stands at 1:25,725 and nurse-patient ratio at 1:11,000 (UBOS, 2012). The doctors tend to get involved in dual practice in order for them to cope with low pay in the public health facilities such as Mulago National Referral Hospital. The results from this study agree with previous studies such as study conducted in Brazil [22] and another study in China [23], while a study done in Italy [24] showed lower scores of 15% among healthcare workers who had a side job. This conforms to Piai-Morais *et al.* (2015) in his conclusion that work overload negatively affects compliance.

In this study, aseptic non-touch technique showed statistical significance with professional cadre and level of education both at Univariate and at bivariate analysis. It was also indicated that Obstetricians were 6 times more likely to comply with the asepsis non-touch technique compared to the midwives. Aseptic non-touch technique is one of the core components of SPIC, which involves a set of actions, aimed at preventing transmission of pathogenic infections to the patient (CDC, 2010). Aseptic non-touch technique vocabulary has been used interchangeably with other words which changes meaning and causes confusion which could contribute to practice variability [25]. The results from this were in congruent with the findings from a study done on two London hospitals [25] where Physicians were more compliant than the nurses in observing the non-touch technique. This could be explained by the different training systems that could have an impact on the practice outcomes especially when it comes to clinical practice [26].

4.2. Hospital Related Factors Associated with Compliance to Standard Precautions of Infection Control in the Management of Labour

In this study, it was also found out that having had an in-service training on standard precautions of infection, control and having seen SOPs were associated to compliance with waste segregation of sharps, waste segregation excluding sharps and observing the Aseptic non-touch technique. The Odds Ratios at bivariate analysis indicated those who had seen SOPs and those who had gone through in-service training in SPIC were two times more likely to comply with these domains of standard precautions of infection control. The main purpose of standard operating procedures is to inform all healthcare workers of the correct steps to follow during the practice of SPIC this is also seen to improve knowledge on SPIC [27]. In a quasi-experimental study on the effectiveness of SOPs

in prevention of needle stick injury among nurses in an Indian hospital, results showed improvement in knowledge between day 9 and 70 with post score of (22.26) on day 70 [27]. In our study, there was significant association between compliance with SPIC and having seen SOPs at Univariate, bivariate and multivariate analysis. This phenomenon is best explained by the behaviourist theory of learning where learning actually occurs when new behaviours are acquired through associations between stimuli. This means that having received training on SPIC, the SOP will be a reminder for the healthcare worker. The WHO (2016) strongly emphasizes that standard operating procedures are in place in all healthcare service delivery systems.

This proves the opportunity to train healthcare workers in SPIC and the management's commitment on patient safety during stay in hospital with aim of preventing Hospital Acquired Infections (HAIs). Training of HCWs on SPIC is a fundamental and immediate need. This need can be identified in a study done in China [23] among 144 nurses where it was evident that less than half of the participants were knowledgeable about SPIC and 98.20% expressed interest to be trained in such measures.

It was also apparent in a recent pragmatic evaluation study in 2 London hospitals [25] where a bigger proportion of staff (37/49, 76%), thought that their practice had greatly improved and 98% of these staff considered the training had helped to standardize aseptic technique practices.

Similar findings were shown in a study done in Brazil [22] where practice of SPIC was highly influenced by availability of standard operating procedures at the hospital and continuous medical training on SPIC. In contrary, an observation study on compliance with infection control and prevention in Kenya Bedoya *et al.*, (2017), concluded that there was a weak association between compliance and availability of all infection control supplies. In service training to all healthcare workers, despite of their professional cadres and academic qualification is vital concerning infection control and prevention in labour suites in order to prevent hospital-acquired infections to all mothers who are in labour.

The results from this study reveal lack of strategic approach for infection control and prevention in the labour suites of Mulago national referral hospital. It was shown in this study that there are no standard operating guidelines in this institution, yet there are several strategies set by the WHO for infection control and prevention in maternal health facilities for developing countries [1]. These strategies include development of an institutional infection control programme which consist of use of infection control and prevention manuals, education and training of HCWs, infection control teams and committees and audit of maternal deaths [28].

5. Study Limitations

This study had the following limitations:

Compliance was measured by direct observation, which would bring about the Hawthorne's effect among the study participants, to minimize on this the re-

searcher utilized direct unobtrusive observation when the healthcare workers performed their procedures in care for mothers in labour.

The other limitation is that the study was cross-sectional in nature, which does not establish the definitive and effect of a relationship between the dependent, and independent variables, this was maximized by combining observation together with interviews from researcher-administered questionnaire.

6. Strengths of the Study

According to my understanding, this study was the first to determine compliance with standard precautions of infection control in management of labour by healthcare workers in Uganda and sub-Saharan Africa.

Compliance was measured by direct observation, which has been considered a gold standard to measure compliance by various researchers.

7. Conclusions

Overall compliance to standard precautions of infection control was low at 52% although it varied across domains.

The findings in this study provide insight into individual and hospital related factors associated with compliance with standard precautions of infection control in management of labour. These factors include: gender, professional cadre, level of education, having had n-service training and availability of supplies for infection control measures at the institution.

8. Recommendations

Based on the above findings in the study, the following recommendations were made

- 1) There is an urgent need to put up interventions to improve on compliance with SPIC in management of labour among all healthcare workers because mothers in labour are at very high risk to acquisition of infections during this course of childbirth.

- 2) Establishment of appropriate strategies and policies which include; accountable infection control committee/team, regular in-service training of HCWs in SP, adequate supply of PPE and provision standard operating procedures in all parts of the facility

9. Implications for Practice

As healthcare workers it is very important to observe compliance with standard precautions of infection control in the management of labour since were in the best position to control/prevent hospital-acquired infection. There's need to strengthen policies regarding infection control and prevent at all levels of management.

Conflicts of Interest

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

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Appendix I: Observation Checklist

CHECKLIST CODE.....
 PERSONAL DATA OF THE HEALTHCARE WORKER
Profession.....
Cadre.....
Qualification.....
Sex.....
Date and time.....

Table A1: Indications for standard precautions of infection control practices, actions and equipment and supplies required for compliance during the management of labour at Mulago National Referral Hospital, Uganda.

1) Indication means a situation in which an infection control and prevention measure has to be undertaken.

2) Corresponding action is the measure the health care worker took in response to an indication where by yes (performed) and no (not performed)

Total compliance means the respondent has scored at least 10/10 of the corresponding actions in response to indications

Table A1. Observation checklist for SPIC.

Standard precaution of infection control domain and indication	Corresponding action for compliance (YES or NO) against each indication of a domain	
Hand hygiene		
1) Before touching the patient		
2) Between patient contact		
3) Before a clean or aseptic procedure		
4) After contact with an object that has touched the patient or was in the patient's immediate environment		
5) Before an invasive procedure (injection, Cannulation and catheterization)		
6) Immediately after removal of gloves		
Total compliance	YES=	NO=
Use of Personal Protecting Equipment (PPE) and antiseptic solutions		
7) Sterile gloves before vaginal examination		
8) exposure to body fluids		
9) sterile gloves, eyewear, plastic apron, covered shoes while conducting a vaginal delivery		
10) Use of freshly prepared ant septic solution to clean the perineum before vaginal examination		
Total compliance	YES=	NO=
Equipment disinfection and cleaning of delivery surfaces		
Cleaned the delivery surface using a disinfectant using a swipe technique		
11) Before and after contact with patient (thermometer)		

Continued

12) before and after patient contact (fetoscope)

13) Before and after patient contact (stethoscope)

14) after patient contact (needle holder, forceps, episiotomy scissors)
placed in a disinfectant for 10 minutes

Total compliance YES= NO=

Waste segregation of sharps

15) After an injection needle placed in the sharps container

16) after cannulation the sharps placed in the sharps container

17) After use of a surgical blade placed in the sharps container

Total compliance YES= NO=

Waste segregation, excluding sharps

18) After an invasive procedure and infectious waste was produced and was discarded in a respective bin

19) after use of a non-reusable equipment (speculum, gloves, catheters) discarded in the corresponding bin

20) after delivery of the placenta, it was discarded in the corresponding bin

Total compliance YES= NO=

Non touch technique

21) During invasive procedures and handling of sterile equipment and linen

Total Compliance YES= NO=

Appendix II: Questionnaire

Questionnaire about individual factors associated with compliance with standard precautions of infection control in management of labour by healthcare workers

Date _____ Time.....

Healthcare worker's study code _____

Section A: individual factors

#	Questions	√
Q3	Gender	1 = Male 2 = Female
Q4	What is your profession?	1 = Midwife 2 = Nurse 3 = Nurse-midwife 4 = Medical officer 5 = Obstetrician
Q5	What is your level of qualification?	1 = Certificate 2 = Diploma 3 = Bachelor's degree 4 = Master's degree

Continued

Q6	What is your work experience?	1 = ≤1 year 2 = 2 - 4 years 3 = 5 - 10 years 4 = ≥10 years
Q7	Do you have a side job?	1 = Yes 2 = No

Section B: Hospital/facility related factors

Q08	Have you ever seen any standard operating procedures of infection control and prevention in this facility?	1 = Yes 2 = No
Q09	Have you ever had an in service training on standard precautions of infection control in this hospital?	1 = Yes 2 = No
