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Prevalence of Hospital Associated Infections and Health Care Workers' Compliance with Hand Hygiene Practices in a Tertiary Hospital in Sokoto, Nigeria

Aminu U. Kaoje¹, Yahaya Mohammed², Zainu M. Sabitu³, Bilkisu G. Abubakar⁴,
Abdulrazaq M. Abduljabbar¹, Zubaidah B. Al-Hassan¹, Lawal Surajo¹, Auwal U. Abubakar⁴,
Ismail A. Raji⁴, Abdulmumini Sa'ad^{1,5}.

¹Department of Community Health, Usmanu Danfodiyo University Sokoto, Nigeria

²Department of Medical Microbiology and Parasitology, Usmanu Danfodiyo University Sokoto, Nigeria

³Department of Medical Microbiology and Parasitology, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

⁴Department of Community Medicine, Usmanu Danfodiyo University Teaching Hospital Sokoto, Nigeria

⁵Independent Consultant/Medical Epidemiologist, Washington DC, USA

Abstract

Background: Hospital associated infections (HAIs) remain a significant cause of morbidity and mortality. And despite the simplicity of hand hygiene practice, an important preventive measure that has been proven to reduce the risk of acquiring and transmitting HAIs, Health care workers (HCW) compliance with the recommendations is of serious concern.

Aim: The aim of this study was to determine the prevalence of hospital associated infections and HCWs compliance with hand hygiene practice in a tertiary hospital.

Methods and material: This was a hospital-based descriptive cross-sectional study among 110 patients on admission selected using universal sampling, and 377 HCWs selected using a multistage sampling technique. Data collected with self-administered questionnaire for HCWs, interviewer-administered proforma for the patients and data extraction sheet for laboratory analysis. Data analyzed for descriptive statistics using SPSS version 20.0.

Results: Patients' mean age was 32.8, IQR: 10.5-37.9 years. Majority, 56(50.9%) were females; Hausa/Fulani, 91(82.7%) and 37(33.6%) had only Qur'anic education while only 20(18.2%) had tertiary education. Health care workers' mean age was 31.8 5.3 years. Majority 227(60.2%) are females, and 267(71.8%) of the participants have received training on hospital infection control. Overall prevalence of HAIs was 42.7%, highest in surgical unit. Commonest HAIs being blood stream infections, and the least, Health Care Associated Pneumonia. Most of the infections were due to *Staphylococcus aureus*, 22(46.8%) and *Pseudomonas aeruginosa*, 14(29.8%). Highest hand hygiene practice was reported after contact with body fluid and highest non-compliance reported was before touching patient. Hand hygiene compliance rate was 49.6% and main reasons to non-compliance were high work load, lack of running water and soap, and regular use of hand gloves.

Conclusions: Prevalence of HAIs was reportedly high, and low hand hygiene compliance and rate despite majority of the HCWs having received training on Hospital infection control. To reduce the prevalence and the associated burden of HAIs, there is need to put in measures to improve compliance to quality hand hygiene practice by health workers.

Keywords: Health care workers, Hospital Associated Infections, Hand hygiene.

Corresponding author:

Aminu Umar Kaoje,

Department of Community Health,
Usmanu Danfodiyo University Sokoto,
Nigeria,
Phone: +234-803-700-3110;
e-mail: aukaoje@gmail.com

Introduction

Hospital associated infection (HAI) is an infection occurring in a patient during the course of care in the hospital or other health care facility, which hitherto not present or incubating at the time of admission (1). The infection can also develop after patient is discharged (2). Hospital Associated Infections represents the most frequent adverse event associated with patient care (3), and of substantial concern especially with regards to patient safety (4), and health care quality globally (5).

In developing countries, HAIs burden is underreported or misclassified because expertise and resources required for complex diagnosis and surveillance activities is lacking (6). At any given time, the HAIs prevalence varies between 3.5-12.0% in developed countries and 5.7-19.1% in low- and middle-income countries, with intensive care unit (ICU) acquired infections ranging from 4.4-88.9% (7). World Health Organization (WHO), noted at any time, over 1.4 million people worldwide develop infectious complications associated with health care (8).

Hand hygiene with soap and water or alcohol-based hand rub remains the primary measure in reducing the risk or preventing HAIs and enhancing patient safety (9, 10). Among patients and healthcare personnel, microorganisms are transmitted to others by indirect contact via staff hands because hand hygiene is neglected or performed inadequately (11). Hand hygiene, before and after all patient or patient environment contact, before a procedure, and after body-fluid exposure, are considered the standard of care for all Health care workers (HCWs) (12).

Studies have demonstrated association between HAIs reduction and increased hand hygiene compliance rates (13-15). However, observation of many HCWs revealed that compliance remains alarmingly low. Hand hygiene compliance levels are considered

excellent at 90% or higher (15). Studies conducted in Ethiopia, Ghana, Kuwait and India revealed an extremely low level of compliance at varying rates at 16.5% (16), 12% (17), 33.4% (18), and 43.4% (19), respectively. In Europe, findings reveal differing compliance rates ranging from 33-65% (20-22). A study to assess HCWs' compliance with Hand hygiene practices in Istanbul revealed a compliance rate of 37.0% (23), while in Georgia reported compliance rate of 76%, with varying rate along workers role ranging from 56-86% (24).

In as much as HCWs wish to comply with proper hand hygiene, it is employer's responsibility to ensure the commodities are readily available and accessible to all HCWs. A study in India revealed some of the barriers as inadequate hand hygiene supplies such as hand sanitizers, hand sinks, and towels, inconvenient placement of hand hygiene supplies, patients overcrowding, work overload and pressure, skin reaction to hand sanitizers, lack of awareness and old habit of not washing hands/forgetfulness (25).

Outbreak of infectious diseases is now a trigger of some attention HAIs and good hand hygiene practices is receiving. On this context, this study is conducted with the aim to determine the prevalence of HAIs and the compliance to hand hygiene practices among health care workers.

Materials and methods

The study was conducted in a tertiary hospital in Sokoto, North Western Nigeria between September and December 2019. It is a 900 bed capacity hospital with 24 clinical departments. The services provided include diagnostic, curative, preventive and rehabilitative services. The hospital has 20 wards and 52 clinics, with an average daily census of 930 patients and a monthly admission rate of 1,585. The bed occupancy rate is 47.5% with an average hospital length of stay of 8 days. The facility staff strength is about 2000, of which 283 are doctors and 644 nurses.

A descriptive cross-sectional design was used to assess the Prevalence of Hospital Associated Infections and Compliance with Hand Hygiene Practices amongst the patients and Health Care Workers respectively. The study population comprised of all patients on admission and all doctors and nurses (here defined as health workers) in the selected tertiary hospital. The patients were recruited for the assessment of prevalence of hospital associated infection while the HCWs for the assessment of level of compliance with hand hygiene practices. The inclusion criteria for the patients, were having being on admission for at least 48 hours and must have developed new symptoms while on admission, or within 3 days of discharge and 30 days of surgical procedure. For health workers inclusion criteria include having been working in the hospital for at least three months, voluntary consent to participate and must be around during data collection. Sample size was determined using formula for descriptive studies,

$n = Z^2pq/d^2$ (26). For the patients, all those on admission and fulfilled criteria for inclusion into HAIs arm of the study (spent at least 48 hours on admission, had no symptoms prior to admission, developed new symptoms 48 hours after discharge) and consented to participate were enrolled. For the hand hygiene compliance arm of the study, the sample size formula was used and factoring for sample adjustment/correction factor due to non-response or loss of part/whole of the filled questionnaire, a sample size of 377 was obtained for HCWs. For patients, universal sampling was used where all the eligible patients on admission were enrolled. For the HCWs, a multi-stage sampling method was used to select the respondents. Stage 1: Selection of Departments: Four departments were randomly selected using simple random sampling by balloting. Stage 2: Proportionate allocation of the number of respondents to be recruited from each Department was done using the calculated sample size. Stage 3: Using a simple random sampling technique by balloting, the respondents were selected from each of the Departments until the allocated number was obtained. An interviewer-administered questionnaires were administered to patients, self-administered questionnaires HCWs, while data extraction sheet was used to retrieve laboratory results from the participating patients' case note. Research assistants were engaged and trained on the conduct of the research, including interpersonal communication skills. Data collection tools were pre-tested among 10% (38) health care workers and 20 eligible patients in a different tertiary hospital. Data cleaning was done manually for completeness and errors on the questionnaires. This was followed by using IBM® SPSS software platform version 20.0. Continuous data were summarized using mean and standard deviation, while categorical data were summarized using frequencies, percentages. Hand hygiene compliance rate was calculated for HCWs and categorized as compliant and non compliant. Compliance rate to hand hygiene by HCWs of 90% or above is said to compliant and less than 90% is said to non-compliance. Results were presented in tables and chart.

Ethical approval was obtained from the Hospital Research Ethics Committee and consent obtained from individual study participants prior to questionnaire administration.

Results:

Patients' average age was 32.8, IQR: 10.5-37.9 years. Majority, 56(50.9%) were females; Hausa/Fulani ethnic group, 91(82.7%) and 37(33.6%) had only Qur'anic education while only 20(18.2%) had tertiary education. Table 1

Out of 210 patients on admission, only 110(52.4%) fulfilled criteria for inclusion in the study. Overall HAIs prevalence in the study centre was 42.7% (95% CI:33.8-52.1). Disaggregation by settings revealed a prevalence of 50.0% in paediatric units, 47.7% in surgical unit, 34.5%

in medical unit and 33.3% each in Gynae ward and ICU. The most prevalent HAIs was Bloodstream infections, 20(42.6%) while the least prevalent was Health Care Associated Pneumonia (HCAP), 5(0.6%). Almost half 22 (46.8%) of the infections were due to *Staphylococcus aureus*, *Pseudomonas aeruginosa* accounted for 14 (29.8%) and the less common organism were *Klebsiella spp.* Table 2.

Table 1. Sociodemographic Characteristics of the Patients

Variable	Number (n=110)	Percentage
Age (years)		
1-10	28	25.5
11-20	19	17.3
21-30	16	14.5
31-40	21	19.1
≥41	26	23.6
Sex		
Male	54	49.1
Females	56	50.9
Ethnic group		
Hausa/Fulani	91	82.7
Others	12	10.9
Yoruba	4	3.6
Igbo	3	2.8
Educational level		
Qur'anic	37	33.6
Primary	25	22.7
Secondary	28	25.5
Tertiary	20	18.2

Table 2. Prevalence and Distribution of HAIs by settings, types and pathogens

Types of HAIs	No. fulfilled HAI criteria	No. of patients with HAIs	Percentage
Overall prevalence	110	47	42.7
HAIs by hospital setting:			
Paediatric Unit	22	11	50.0
Paediatrics wards	12	6	50.0
Special care/baby unit (SCBU)	10	5	50.0
Surgical Unit	44	21	47.7
Urology ward	12	6	50.0
Neurosurgery ward	8	4	50.0
Female surgical	8	4	50.0
Paediatric Surgical ward	8	4	50.0
Male surgical	8	3	37.5
Medical Unit	29	10	34.5
Male medical	15	5	33.3
Female medical	14	5	35.7
Gynae Unit	12	4	33.3
ICU	3	1	33.3
HAIs by types *			
Blood stream infections		20	42.6
Catheter associated UTIs		15	31.9
Surgical site infections (SSIs)		13	27.7
Health Care Associated Pneumonia (HCAP)		5	10.6
HAIs by Causative organisms *			
<i>Staphylococcus aureus</i>		22	46.8
<i>Pseudomonas aeruginosa</i>		14	29.8
<i>Streptococcus pneumoniae</i>		11	23.4
<i>Escherichia coli</i>		4	8.5
<i>Klebsiella spp.</i>		3	6.4

*multiple responses allowed

Of the five patients that had previous history of positive culture, four were positive for ESBL and one for MRSA. Most 44 (93.6%) of the patients with HAIs have indwelling urinary catheter and 20 (42.6%) each had a nasogastric tube, arterial lines and ventilator use. Slightly above three-quarters 36 (76.6%) had used Ciprofloxacin, 33 (70.2%) used Ceftriaxone and about a half, 22 (46.8%) used Amoxicillin-clavulanic acid. Most 39 (83.0%) had a prior history of hospital admission, and the majority, 30 (63.8%) had surgery within the last three months. A little above a quarter of the patients, 13 (27.7%) have decubitus ulcer while HIV/AIDS and his-

history of recent haemodialysis were the least reported co-morbidities. Table 3.

Table 3. Respondents' Past Medical and Co-Morbidities History (n=47)

Variables	No. of patients	Percentage
Past Medical History (n=47)		
Previous history of positive culture (within the past 4 weeks)		
Extended Spectrum Beta Lactamases (ESBL)	4	8.5
Methicillin Resistant <i>Staphylococcus aureus</i> (MRSA)	1	2.1
History of Device Utilization (at present or in the past 4 weeks)		
Indwelling catheter	44	93.6
Nasogastric tube	20	42.6
Arterial lines	20	42.6
Ventilator use	20	42.6
Central venous line	1	2.1
Endotracheal tubes	1	2.1
Prior Antibiotic Usage in the last four weeks		
Ciprofloxacin	36	76.6
Ceftriaxone	33	70.2
Amoxicillin-clavulanic acid	22	46.8
Cefotaxime	5	10.6
Gentamycin	3	6.4
Trimethoprim-Sulfamethoxazole	1	2.1
History of Co-morbidity (n= 47)		
Prior history of hospital admission	39	83.0
Surgery within last 3 months	30	63.8
Presence of decubitus ulcer	13	27.7
Trauma / Fracture	11	23.4
Diabetes mellitus	11	23.4
Presence of neutropenia	6	12.8
Use of steroids (≥20mg daily for ≥2 weeks)	2	4.3
HIV/AIDS	2	4.3
History of recent Haemodialysis	2	4.3

Health workers' overall mean age was 31.8 ± 5.3 years. Slightly above half, 192 (52.0%) of the respondents were in the 25-39 years age group. Majority, 227(60.2%) were females, Hausa 200(53.1%), Muslims 240(64.0%), while 262(69.5%) were married. Majority, 230(61.2%) had less than five years of work experience and about three-quarters had received training on hospital infection control. Table 4.

Table 4: Socio-Demographic and work-related characteristics of the Health workers

Variables	Number	Percentage
Age (years)		
19-24	82	21.8
25-39	196	52.0
≥40	99	26.2
Gender		
Male	150	39.8
Females	227	60.2
Tribe		
Hausa	200	53.1
Yoruba	110	29.2
Igbo	40	10.6
Others	27	7.2
Religion (n=375)		
Muslim	240	64.0
Christian	129	34.4
Others	6	1.6
Marital Status		
Married	262	69.5
Single	107	28.4
Divorced	4	1.1
Widow	4	1.1
Occupation		
Doctors	100	26.5
Nurses/Midwives	277	73.5
Years of service in the hospital (n=376)		
<1	100	26.6
1-4	130	34.6
5-9	90	23.9
≥10	56	14.9
Training Received on Hospital Infection Control (n =372)		
No	105	28.2
Yes	267	71.8

Highest hand hygiene practice were reported for after contact with body fluid, (52.5%), while the highest non compliance was reported for hand hygiene before touching patient, (85.1%), followed by after removing hand gloves by 66.0%. Figure 1.

Figure 1: Assessment of Hand Hygiene Practices

Overall hand hygiene compliance rate was 49.6% (95% CI:48.9-50.3). Disaggregation by hand hygiene opportunities revealed compliance rate of 84.6% after body fluids exposure, followed by before performing a procedure on a patient, 82.6%. The lowest compliance rates of 21.0% was reported for before touching a patient and patient surrounding. Table 5.

Table 5: Hand Hygiene Opportunities and Compliance Rate among HCWs

Characteristics	No. of Hand hygiene Opportunities	No. of hand hygiene performed	Compliance rate (%)
Before touching a patient and patient surrounding	5979	1257	21.0
Before performing a procedure (clean/aseptic) on a patient	2568	2120	82.6
After body fluids exposure or contact	2047	1731	84.6
After direct contact/ touching a patient	3688	1461	39.6
After removing hand gloves	3332	2167	65.0
Overall compliance rate	17,614	8,736	49.6

Most cited barrier was high workload by 88(23.3%) of the respondents, closely followed by lack of running water and soap, 80(21.2%), and regular use of hand gloves 79(21.0%) and lack of alcohol-based hand rub 77(20.4%). Table 6.

Table 6: Barriers to routine hand hygiene performance

Variables	Frequency	Percentage
High workload (often too busy)	88	23.3
Lack of running tap water and soap	80	21.2
I always wear hand gloves, so no need for hand hygiene	79	21.0
Lack of alcohol-based hand rub	77	20.4
Lack of enforcement by the hospital management	71	18.8
Lack of knowledge of guidelines/protocols on hand hygiene	61	16.2
Lack of hospital priority for hand hygiene	53	14.1
Lack of displayed HH poster at point of care for remembrance	52	13.8
Often forget to perform hand hygiene	52	13.8
Low risk of acquiring infection from patients	51	13.5
Lack of administrative sanction of non-compliers	39	10.3
Sceptic about the value of hand hygiene practices	37	9.8
Hand hygiene agents affect patients	35	9.3
My teachers or superiors don't do hand washing or rubbing	33	8.8
Hospital management not providing products regularly	32	8.5
Hand washing agents cause irritation & dryness of the skin	20	5.3
Lack of knowledge, experience and education	6	1.6

Multiple responses allowed

Discussion

This study aimed to determine the prevalence of hospital associated infections and health workers compliance to hand hygiene performance in a tertiary hospital. The study revealed a point prevalence of HAIs, which was also found to differ by hospital settings and health workers role. This very high prevalence rate depicts the unpleasant situation of infection prevention and control practices. Every one of two patients admitted to paediatric and surgical units developed HAIs making these places the most dangerous place for the

patient to be in respect to safety and quality of care. Although not all HAIs are preventable, majority of the infection can be prevented if there is excellent adherence to hospital infection prevention and control guidelines by health workers largely and patients themselves. The low compliance rate to hand hygiene in this study may largely be responsible for the high HAI prevalence. The patients' medical characteristics may have also partly contributed to this very high rate. It was observed that all the patients had a history of co-morbidities and device utilization such as an indwelling urinary catheter and nasogastric tube. Many others also had prior history of hospital admission, surgeries within the last three months and antibiotic use, many of which are very likely to be self-prescribed. Loss of efficacy of disinfectants from over-dilution by hospital cleaners and or substandard disinfectants may not be ruled out as also a possible risk factor for the reported HAI prevalence. More than a third of the HAIs were Bloodstream and Catheter associated Urinary Tract Infections mostly due to *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Device use such as intravenous line and urethral catheter on patient is common practice in this setting. Nearly every patient on admission must have intravenous line for rehydration and intravenous drug administration. A study conducted in eight university hospitals of Iran reported an overall HAI prevalence of 9.4% with the most common HAIs being bloodstream infections, SSIs, UTIs, and pneumonia (27). A study in Singapore reported 11.9% mainly caused by *S.aureus* and *Pseudomonas aeruginosa* (28). Studies on HAI from Southeast Asian countries found an overall prevalence rate of 9.1% with the most common microorganisms being *P. aeruginosa*, the *Klebsiella* species, and *Acinetobacter baumannii* (29). In contrast, a study from Florida, USA revealed that *Staphylococcus aureus* was the most frequently detected microorganism among HAI patients (30). *Staphylococcus aureus* being the normal flora organism and asymptotically carried in nostril of significant proportion of population, easily become a culprit.

Health workers hand are germ farm and therefore are a viable vehicle for cross-transmission of infectious agents. Although HCWs are expected to practice good hand hygiene to remove visible soiling from hands, to prevent the transfer of bacteria from the home to the hospital, to prevent transfer of bacteria from the hospital to the home, single most important reason is to prevent infections that patients acquire in the hospital called hospital associated infections (HAIs). The overall hand hygiene compliance rate in the study setting was found to be 49.6%, and this was also found to differ across the WHO 'My five moments of hand hygiene'. It was highest after body fluids exposure or contact/risk and before performing a procedure(clean/aseptic) on a patient. Very few respondents reported performing hand washing/decontamination across the 'five moments' always, as a substantial number rarely or never

perform. The study finding is not comparable with recommended 90% or higher considered excellent for hand hygiene compliance rate required to achieve a predictable risk reduction in infection rate (15).

Studies conducted in Ethiopia, Ghana, Kuwait and India, revealed an extremely low level of compliance at varying rates of 16.5% (16), 12% (17), 33.4% (18), and 43.4% (19), respectively. Similarly, a low compliance rate of 37% was reported from a study in Istanbul (23). Also, reports from studies in Europe revealed differing hand hygiene compliance rates ranging from 33 to 65% (20-22). Similarly, in Georgia, the compliance rate of approximately 76%, was reported though with varying rate along workers role ranging from 56% to 86% (24). Although all reports from the different studies were substantially below the compliance level considered excellent, the finding were worse in low- to middle-income countries. The variations could be attributed to a low commitment by health care managers and lack of adequate resources towards infection control practices. In as much resources committed will continue to be negligible, the HAIs will remain endemic and the associated burden will continue to rise and compromise patient safety and quality of care. If not properly handled particularly in developing countries, it is likely to lead to a level of public health emergency of international concern. This poor compliance to hand hygiene by HCWs is likely to facilitate cross-transmission of infection among patients in the hospital as the world is faced with COVID 19 pandemic. Compliance to hand hygiene with soap and water or alcohol-based hand rub is only second to social and physical distancing approach to breaking the chain of local and community transmission.

Many reasons hand hygiene practice is not adhered to were reported, and most self-reported for poor compliance were high workload, lack of running water and soap, regular use of hand gloves and lack of alcohol-based hand rub. Among other duties and responsibilities of health care managers as an employer is to ensure the availability and accessibility of hand hygiene commodities to all categories of health workforce at all times. In the Leggs aphorism, it was stated 'Unless and until the employer has done everything-and everything means a good deal-the workman can do next to nothing to protect himself although he is naturally willing enough to do his bit (31).

A study revealed some of the reasons as inadequate hand hygiene supplies such as hand sanitizers, hand sinks, and towels, Inconvenient placement of hand hygiene supplies, patients overcrowding, Work overload and pressure, skin reaction to hand sanitizers, lack of awareness and old habit of not washing hands/forgetfulness (25). A study among health care workers in a public hospital in Kano, reported multiple constraints to hand hygiene the majors being lack of water and/or lack of soap, as well as lack of alcohol hand rub. Other constraints included not knowing how to wash hands,

no place provided for washing hands, no time to wash hands while at work, and not remembering to wash hands while at work (32). A study from Southern Nigeria, reported lack of hand hygiene facilities such as clean towels, hand lubricants, running water, soap, water sinks not conveniently placed as barriers to complying regular hand hygiene (33). While some provider reported anticipated difficulties in ensuring regular hand hygiene even if the facilities are available because of lack of time, heavy patients traffic, non- conducive atmosphere, and forgetfulness (17). Another study from India revealed hand hygiene Barriers as inconvenient placement of Hand hygiene facility, overburden of patient care, forgetfulness, Sore hands/abrasions on hands, Hand hygiene unnecessary when gloves are worn, belief of low risk of acquiring infection from patients, among others (34). These barriers are cross-cutting and overcoming most of them is sole duties and responsibilities of the employer. As long as these barriers continue to prevail, the hand hygiene practice will be unimplementable, thereby increasing the HAIs with their associated burdens.

The limitation is that self-reported information were used. This form of data gathering could be prone to bias by overestimating their adherence to hand washing rules. There is also likelihood to inaccurately recall their past Hand Hygiene behaviour including number of opportunities to perform hand.

In conclusion, Hospital Associated infections remains high as evidenced by high prevalence in different hospital settings. The hospital management should ensure continuous availability and accessibility of hand hygiene commodities to all. There is also need to strengthen the infection prevention activities and ensure regular environmental surveillance and risk assessment. Further researches are required to the role of HCWs uniform cross-transmission of microorganism and also assess the efficacy of different cleaning solution used in hospital disinfection.

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