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Association Between Nurses' Years of Practice and Knowledge on Insulin Therapy at Edward Francis Small Teaching Hospital, the Gambia: A Cross-sectional Study

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Abstract: The purpose of this study was to measure the association between years of nursing practice and knowledge of insulin therapy among nurses in Edward Francis Small Teaching Hospital, The Gambia. A hospital-based descriptive cross-sectional study was conducted among 127 randomly selected trained nurses. Data were collected using a self-administered questionnaire. Data were analysed using IBM SPSS version 20. A total of 127 nurses participated in this study but 118 completely filled and returned the questionnaires making a total response rate of 93%. The mean years of experience of nurses was 3.86 ± 4.051 years with a minimum of 1 year (20.3%) and maximum of 23 years (0.8%). Most of the nurses were females (n = 66, 55.6%), had a diploma in nursing (n = 75, 63.6%) and working at the surgical department (n = 47, 39.8%) respectively. The majority (n = 93, 78.8%) of them had never attended an in-service training on management of diabetes. The majority of nurses rated their knowledge of diabetes as good (n = 72, 61%). Despite this self-rating, 114 (96.6%) of them would like to receive extra training on insulin therapy. Eighty-six percent (n = 102) of the nurses knew the normal range of fasting blood sugar level and 98.3% said that blood sugar level should be checked prior to administering insulin (n = 116). However, most of them did not know that a blood sugar level of less than 70 mg/dl in a diabetic patient is classified as hypoglycaemia (n = 77, 65.3%). There were significant mean differences of the nurses' years of experience in relation to their willingness to attend an in-service training on DM management and knowledge of sign and symptoms of hypoglycaemia ($p < 0.05$). The majority (87.3%) and (91.5%) of the nurses practiced injection site cleaning and priming of the insulin syringe respectively. However, 33.1% (n = 39) of the nurses do not wash their hands and only 4.2% (n =5) of them reported checking for expiry date prior to giving insulin injection. In addition, 72.9% (n = 86) of the nurses reported administering insulin injection in the arm. The nurses with more than four years of practice were more knowledgeable on the requirements of effective insulin administration than those with two years or less practical experience. The findings of this study highlight the urgent need for an educational intervention on diabetes and insulin therapy for the nurses in EFSTH.

Keywords: Nurses, Knowledge, Insulin, Therapy, Diabetes, EFSTH, The Gambia

1. Introduction

Diabetes mellitus (DM) is a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism, resulting from defects in insulin secretion, insulin action, or both [1]. DM has proved to be the most common global public chronic disease that is associated with serious long term effects and escalating healthcare costs [2]. Existing

studies have revealed definite global increase in its incidence and prevalence [3-5]. The International Diabetes Federation [3] reported that the DM prevalence was 415 million people worldwide in 2015 and this number is going to increase to 642 million people by 2040. This report continued to indicate that 15.5 million of the DM incidence was from the African Region, representing a regional prevalence of 3.3%. The highest prevalence of diabetes in the Region is found in adults aged 55 to 64 [3-6]. The prevalence of diabetes is even higher in The Gambia estimated at 5.8% [2].

The main purpose of DM treatment is to prevent the development of complications that worsen quality of life or even cause deaths. To achieve this, insulin therapy has been used to keep the blood sugar within normal range and prevent acute and chronic complications [5, 6]. Insulin therapy is a lifesaving treatment for hyperglycaemic patients in the hospital setting. Insulin can be stored in a refrigerator for approximately 3 months or kept at room temperature (15 – 25°C) for 28 days [6-8]. Health care professionals need to draw their attention to all areas relating to insulin treatment to achieve optimal glucose control in the blood [9, 10]. Nurses are often the first point of contact for people seeking information on diabetes care [10] and therefore have a major role in administration of insulin as well as the responsibility of identifying the suspicious signs of hyperglycemia and hypoglycemia. Inadequate knowledge of nurses on insulin treatment can cause errors and several adverse outcomes. Errors related to insulin treatment and application includes problems with insulin administration timing, type as well as the route of administration or injection technique [11, 12]. It is therefore expected that nurses should have information about how insulin works, when and why insulin is needed, how dosing regimens and how changes are made [13]. Therefore, the purpose of this study was to determine the level of knowledge of insulin therapy among nurses in Edward Francis Small Teaching Hospital, The Gambia. Search of the literature did not reveal any similar study conducted in The Gambia. Hence, this study is highly needed to fill this knowledge gap.

2. Materials and Methods

2.1. Study Design

A hospital-based descriptive cross-sectional study design was used.

2.2. Study Setting

The study was conducted at Edward Francis Small Teaching Hospital (EFSTH), Banjul, The Gambia. At EFSTH, there are two distinct categories of nurses, i.e., trained (Registered nurses) and untrained nurses (nurse assistants/attendants). Majority of the trained nurses are not specialized in any particular nursing specialization area and so are subject to rotation to various departments within the hospital according to hospital policy. For example a nurse working in a paediatric ward can be moved to an adult medical ward depending on demands. Nurse assistants have not undergone nurse training in a training institution but are trained on the job and serve assistants to the trained nurses.

2.3. Target Population

According to the staff records at EFSTH [14], 400 nurses were working in the hospital during the study period. The eligibility criteria for this study included all trained nurses working at EFSTH during the period of the data collection and consented to participate in the study. Nurses working in the wards of the various departments, for example the Surgical, Obstetric and Gynae, Medical and Accident and Emergency Departments were included because they do care for patients with diabetes and its complications such as management of diabetic foot ulcer and amputation, diabetes in pregnancy and diabetic coma. However, among the trained nurses working in Paediatric Department, only nurses working at the Paediatric Surgical Unit were included in the study since they do care for children with diabetes and within the age group of 7 to 14 years. Nurses working outside the ward setting or on leave were excluded from the study.

2.4. Sampling Size and Sampling Technique

The sample size was calculated using the Research Advisor Sampling Template, using a population size of 400 nurses in EFSTH, set at a confidence interval of 95% and a marginal error (degree of accuracy) of 5% to give a required sample size of 115 nurses. To make up for possible non-response and incompletely filled questionnaires, 10% of the calculated sample size was added to increase it to 127 respondents. These respondents were selected using simple random sampling. The EFSTH staff list was used as the sampling frame.

2.5. Data Collection Tool

The instrument used in this study was adapted from another study [1] with few alterations made to best suit The Gambian context but not to the detriment of the retention of important information the survey intends to provide to and from study participants. This structured questionnaire consists three parts, of which one part was dealing with the nurses' socio-demographic characteristics, while the other two parts were measuring the nurses' knowledge of DM and administration of insulin therapy such as insulin effects, complications of insulin treatment, insulin administration routes, insulin preservation, and hypoglycaemia indications and treatment.

2.6. Scoring of the Questionnaire

Part 2 which measured knowledge on diabetes had 5 questions and 20% was assigned to correct answer for each question. The total possible score was 100% and a score of 0 – 59 was graded as low knowledge and 60 – 100% as high knowledge.

Part 3 measuring knowledge on insulin administration had 13 questions. Each correct answer was scored 1 and incorrect

answer scored 0. The total percentage score on each item by individual respondent was calculated and 0 – 59% was categorized as low knowledge while 60% -100% was high knowledge.

2.7. Validity and Reliability of Study Questionnaire

The study tool was sent to three endocrinology and research experts to critique for comprehensiveness, representativeness and clarity so as to ensure it measures what it was purported to measure in the Gambian context. The questionnaire was pilot tested among ten nurses from Serekunda Hospital and the total reliability coefficient of the questionnaire was 0.81.

2.8. Data Collection

Data was collected using self-administered method which lasted for one month (August, 2018). The researchers went from ward to ward distributing the questionnaires to the nurses. The researchers were available to respond to doubts or questions from the respondents and to ensure that they answered the questions individually.

2.9. Data Analysis

Data was analysed using IBM SPSS version 20. Categorical variables were presented as frequencies and percentages. Independent sample t-test was used to compare means between two groups. One way Analysis of variance (ANOVA) was used to compare means between more than two groups. The level of statistical significance was set at $p < 0.05$.

2.10. Ethical Approval

Approval to conduct the research was obtained from the Hospital's Research Review Board. The study respondents signed informed consent forms.

3. Results

3.1. Demographic Characteristics of Study Respondents

A total of 127 nurses participated in this study but 118 completely filled and returned the questionnaires making a total response rate of 93%. The mean years of experience for nurses was 3.86 ± 4.051 years with a minimum of 1 year (20.3%) and maximum of 23 years (0.8%). As shown in Table 1, most of the nurses were females (n = 66, 55.6%), had a diploma in nursing (n = 75, 63.6%) and working at the surgical department (n = 47, 39.8%) respectively. Majority (n= 93, 78.8%) of them had never attended an in-service training on management of diabetes. Table 1 also shows that the mean differences of nurses' years of experience by socio-demographic characteristics. The male nurses (mean = 4.21±4.620) had longer years of work experience than their female counterparts. There was also a significant difference in their years of nursing experience between their highest level of education and those who said they had attended an in-service training on management of diabetes ($p < 0.05$). However, there was no statistically significant differences between their years of experiences and the different departments nurses worked in.

Table 1. *Mean differences of nurses' years of experience by socio-demographic characteristics.*

Socio-demographic characteristics	N=118	%	Years of experience Mean ±SD	P value
Sex				
Male	52	44.1	4.21± 4.620	0.035*
Female	66	55.9	3.59± 3.552	
Educational Level				
Diploma	75	63.6	3.77± 3.941	
University Degree	42	35.6	3.57± 3.125	<0.001*
Master degree	1	0.8	23.00± 0.0	
Department				
Medicine	29	24.6	3.45± 3.680	
Surgery	47	39.8	3.85± 4.102	
Paediatrics	10	8.5	2.40± 1.075	0.542
Accident &Emergency/ICU	25	21.2	4.60± 5.066	
Obs&Gyne	7	5.9	5.14± 3.848	
Attended In-service DM training courses				
Yes	25	21.2	4.84± 6.019	0.004*
No	93	78.8	2.60± 2.330	

*p value < 0.05 is significant

3.2. Sources of Information on Diabetes and Insulin Therapy

Sixty-two (52.5%) of the nurses revealed that their most important source of information on DM and insulin treatment was the nursing training institutions while 9 (7.6%) said seminars/workshops (Table 2).

Table 2. *Source of information on DM and insulin treatment (n = 118).*

Items	Frequency	Percentage (%)
None	2	1.7
Doctors	9	7.6
Nurses	13	11.0
Self	15	12.7
Nursing training institution	62	52.5
Seminar/workshop	9	7.6
Media	8	6.8

3.3. Knowledge of Diabetes Among Nurses

The majority of nurses rated their knowledge of diabetes as good (n = 72, 61%). Despite this self-rating, 114 (96.6%) of them would like to receive extra training. The nurses with 1 year nursing experience (mean = 1.36± 0.867) reported more that they would like to receive extra in-service training on diabetes management (n = 114, 96.6%) than those with 5 or more years of experience. Thus, there was a significant mean difference of the nurses' years of experience in relation to their willingness to attend an in-service training on DM management (p = 0.026).

Eighty-six percent (n = 102) of the nurses knew the normal range of fasting blood sugar level and 98.3% said that blood sugar level should be checked prior to administering insulin (n = 116). However, most of them did not know that a blood sugar level of less than 70 mg/dl in a diabetic patient is classified as hypoglycaemia (n = 77, 65.3%). The most known signs of hypoglycaemia among the nurses were a feeling of a dry mouth (n = 37) and blackout (n = 36) whilst that of hyperglycaemia were dry mouth (n= 39) and frequent urination (n = 30). Most of the nurses' general level of knowledge on diabetes was low (n = 71, 60.2%). However, the nurses with 4 more years of nursing experience were more likely to have high level of knowledge on diabetes than those with 2 or lesser years of experience (p = 0.037).

Table 3. *Mean differences of nurses' years of experience by knowledge of DM.*

Knowledge about DM	N=118	Percentage	Years of experience Mean±SD	P value
Self-rating of knowledge of DM management				
Poor	3	2.5	2.33± 1.155	
Fair	38	32.2	3.26± 2.678	0.605
Good	72	61.0	4.21± 4.602	
Excellent	5	4.2	4.40± 5.413	
Would you like to receive an extra in-service training on DM management				
Yes	114	96.6	1.36± 0.867	0.026*
No	4	3.4	4.67±.1.543	
Normal fasting blood sugar level				
< 3.8mmol	10	8.5	3.10±0.876	
3.5 – 5.5mmol	101	85.6	3.83±3.988	0.499
>5.5mmol	7	5.9	5.43±7.068	
Should blood sugar level be checked always before administering insulin?				
Yes	116	98.3	3.85± 4.072	0.969
No	2	1.7	4.50± 3.536	
Hypoglycemia is blood sugar level less than 70mg/dl				
Yes	41	34.7	3.37±.2.690	0.030*
No	77	65.3	4.13±.4.609	
Signs and symptoms of hypoglycaemia include:				
Dizziness	20	16.9	2.75± 1.372	
Blurred vision	13	11.0	2.46± 1.050	
Blackout	36	30.5	3.64± 4.065	0.005*
Dry mouth	37	31.4	3.92± 4.252	
Sweating	12	10.2	7.75± 6.092	
Signs and symptoms of hyperglycemia include:				
Headache	14	11.9	2.71± 0.825	
Dizziness	27	22.9	4.63±5.746	
Dry mouth	39	33.1	3.44± 3.169	0.594
Polyuria	30	25.4	4.27± 4.042	
Sweating	8	6.8	3.88± 4.643	
General level of knowledge of diabetes				
Low	71	60.2	2.62±2.654	0.037*
High	47	39.8	4.23±4.603	

*p value < 0.05 is significant

3.4. Nurses' Knowledge of Insulin Therapy

The results presented in Table 4 show that the majority (87.3%) and (91.5%) of the nurses practiced injection site cleaning and priming of the insulin syringe respectively. However, 33.1% (n = 39) of the nurses do not wash their hands and only 4.2% (n =5) of them reported checking for expiry date prior to giving insulin injection. In addition, 72.9% (n = 86) of the nurses reported administering insulin inject in the arm. The total knowledge of the nurses on insulin therapy was low (n = 84; 74.6%). There were significant mean differences of the nurses' years of experience in relation to priming of the insulin syringe, washing of their hands, time of hand wash while giving insulin and the frequency of insulin syringe use (p < 0.05).

Table 4. *Mean differences of nurses' years of experience by knowledge on implementation of insulin therapy.*

Knowledge on Insulin Therapy	N=118	Percentage	Years of experience Mean±SD	P value
Is hypoglycemia the most common complication of insulin therapy?				
Yes	98	83.1	2.80± 3.731	0.100
No	20	16.9	1.20± 0.464	
Do you check expiry date before giving insulin?				
Yes	5	4.2	4.80± 0.447	0.102
No	113	95.8	3.96± 0.115	
Do you remove air from the syringe while giving insulin?				
Yes	108	91.5	4.04± 4.185	0.037*
No	10	8.5	2.00± 0.943	
Do you use alcohol swab before injecting insulin?				
Yes	103	87.3	3.96±4.132	0.877
No	15	12.7	2.20± 1.489	
Do you change injection site daily?				
Yes	81	68.6	4.02±2.102	0.531
No	37	31.4	1.51± 1.969	
Do you examine injection site for pain and swelling?				
Yes	101	85.6	3.93±3.973	0.583
No	17	14.4	1.47±.1.598	
Do you pinch up the skin with index and middle finger while giving insulin?				
Yes	95	80.5	3.85±.3.984	0.222
No	23	19.5	1.91±.1.410	
While giving insulin, when do you release the pinch of skin?				
Before removing the insulin syringe	43	36.4	3.67±4.385	
After removing the insulin syringe	66	55.9	4.17±4.067	0.500
I don't know	9	7.6	1.56±1.333	
Do you inject through clothes while giving insulin?				
Yes	2	1.7	1.50±.2.121	0.615
No	116	98.3	3.89±4.077	
Do you wash your hands while giving insulin?				
Yes	79	66.9	4.49± 3.189	<0.001*
No	39	33.1	1.14± 0.744	
When do you wash your hands while giving insulin?				
Before touching the patient	50	42.3	4.00±2.667	
Before withdrawing the insulin	29	24.6	2.66±1.289	0.030*
I don't wash my hands	39	33.1	1.14±0.744	
Which insulin injection site do you usually use?				
Arm	86	72.9	3.92±4.449	
Abdomen	26	22.0	4.12±2.875	0.504
Thigh	6	5.1	2.00±1.265	
Which angle do you use to administer insulin?				
25 degree	30	25.4	3.77±4.256	
45 degree	82	69.5	3.94±4.114	0.930
90 degree	6	5.1	3.33±2.066	
How many times do you use an insulin syringe?				
Once	68	57.6	4.60±4.694	0.001*
More than once	50	42.4	1.86±2.695	
Do you dispose insulin in sharps container?				
Yes	105	89.0	4.03±4.166	0.270
No	13	11.0	1.54±2.727	
What are the types of insulin used in the Gambia?				
Both mixtard and soluble insulin	32	27.1	5.22± 5.901	
Either mixtard or soluble insulin	40	33.9	3.78±3.899	0.057
I do not know	46	39.0	1.00±1.850	
For how long should insulin kept at room temperature be used?				
16days	32	27.1	4.97±4.935	
28days	60	50.8	4.05±4.127	
40days	4	3.4	2.25±1.500	0.100
80days	2	1.7	1.00± 0.000	
I do not know	20	16.9	1.15±1.182	
General level of knowledge score				
Low	88	74.6	2.58±1.759	0.174
High	30	25.4	4.70±4.779	

*p value < 0.05 is significant

4. Discussion

Most of the nurses had years of experience less than 5. This could be attributed to the high turnover of nurses in The Gambia [16]. Similarly, Adhikari, *et al.,* and Mohammed [15, 17] reported that younger and less experienced nurses contributed to suboptimal patient care. Nurses are crucial frontline healthcare professionals and are responsible for proper insulin administration for diabetics admitted in the hospital. Therefore, their knowledge about insulin treatment can help them to properly serve their main role as guardians of patient's safety. The success of diabetic mellitus (DM) treatment with insulin does not only depend on the type and dose of insulin administration but also in the technique of administration [1].

The finding that most of the nurses would like to have extra training on DM management is similar to the findings from the studies conducted by Chrysoula and Findlow [9, 18] that 84.1% and 94.8% of their respective respondents would like to be trained in the organization and application of insulin treatment. Furthermore, the nurses in this study reported that nursing training institutions were their most important source of information on insulin therapy. It could be inferred then that nurses with longer years or advanced training in any nursing institution were more likely to have better knowledge. Hence there was a significant differences between level knowledge of insulin therapy and years of experience.

In our study, most of the nurses could not ascertain what value a hypoglycaemic blood sugar should read in a patient and there was significant relationship between nurses' years of experience and sign and symptoms of hypoglycemia. Having adequate and comprehensive knowledge of diabetes and insulin therapy is important since nurses are responsible for giving health education on the use and complications of insulin to a patient upon their discharge from the hospital. According to the guidelines from the American Diabetes Association and International Foundation diabetes [19], specialized knowledge on insulin-dependent diabetes mellitus and skills are required by nurses.

It is important that healthcare practitioners check the manufacturer's recommendation for proper storage conditions [20] because storage of insulin at inappropriate temperature decreases the potency and pharmacological action of insulin [21-22]. Most of the nurses in this study were aware of the recommendations for insulin storage at room temperature. Contrasting findings were reported among nurses in Nepal [15] and Kenya [23].

There are three areas that generally could be used for injecting: thighs, abdomen and buttocks. Injecting into the arms is always avoided unless advised by the diabetes team because there is an increased risk of hypoglycaemia when injecting into the arms as these injections might become intra-muscular rather than subcutaneous [24]. However, majority of the nurses in this study reported using the arm as site of injecting insulin. Wrong route of administration was found to be a common error when administering insulin in a study conducted in Kenya [23]. Before injecting a patient with insulin, it is recommended that nurses follow the principles of anti-septic and non-touch technique [23]. Even though majority of the nurses claimed that they use alcohol swab to clean the injection site before injecting, there were significant statistical difference in years of experience with performing hand hygiene. Such practice could lead to unpredictable clinical outcomes [18-20] and is against the policy for safe administration of insulin [21-23]. There was significant relationship between the nurses' years of experience and frequency of insulin syringe re-use. Needle re-use is usually associated with contamination, infection and increased risk of lipo-hypertrophy. The risk of lipo-hypertrophy significantly increases with the use of needles for more than five times [25].

5. Strengths and Limitation of the Study

Knowledge of proper use of insulin is indispensable and essential to patient safety. To our knowledge, this is the first study in The Gambia to report the knowledge of nurses on insulin therapy. However, this study was limited to a single centre which is the only teaching hospital in the country as at the time of the study and thus the findings might not be generalized. This study used self-administered questionnaire. In the knowledge section, most of the responses had 'yes or no' option which could cause a high risk for guessing.

6. Conclusions

This study investigated the association between years of nursing practice and knowledge of insulin therapy among nurses in Edward Francis Small Teaching Hospital. The general knowledge levels of the nurses on DM and insulin therapy were low. The findings identified the need for improvement in the knowledge and practice of care of diabetic patients among the nurses with less practical experience. Inadequate knowledge on diabetes management among nurses can lead to reduced knowledge of the patients as a result of inadequate health education and invariable poor health outcome. This can cause undermined confidence of patients on nurses and thus reduce the confidence of patients in the health system.

7. Recommendations

The results of this study highlight the need for urgent educational intervention for the nurses with less than 2 years practical experience on the application of insulin therapy. Thus, it is important to develop a plan for continuing education and organize training programs to improve the knowledge and skills of nurses on the care of people with diabetes in EFSTH. From the participants response to hand washing practice, it is imperative that studies be conducted on infection control and hand hygiene practice of the nurses in this hospital.

List of Abbreviations

DM - Diabetes Mellitus
EFSTH - Edward Francis Small Teaching Hospital

Consent for Publication

All the authors consented for the publication of this article.

Availability of Data and Material

The data that supports the findings of the current study are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

Tobiloba Oyejide Alex Omotosho, Tomilayo F. Omotosho, and Pateh Saho took part in conceptualization. Tobiloba Oyejide Alex Omotosho and Tomilayo F. Omotosho took part in recruitment of participants, data collection, compilation and entry. Tobiloba Oyejide Alex Omotosho wrote the manuscript. Tobiloba Oyejide Alex Omotosho and Haddy Tunkara-Bah analyzed and interpreted data. Haddy Tunkara-Bah reviewed it critically for important intellectual content and gave approval for publication. All the authors read and approved the final manuscript.

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References

[1] Alwan AH, Alhusuny A. Knowledge and practice about diabetes mellitus and insulin injection technique among nurses in general hospitals, Al-Hillah City. IOSR J Dental and Med Sci. 2014; 13 (9): 28-32.

[2] World Health Organization (WHO): World Health Day Beat diabetes. http://www.who.int/diabetes/en/(2016). Accessed 20 October 2018.

[3] International Diabetes Federation (IDF): http://www.diabetesatlas.org/ (2016). Accessed 22 October 2018.

[4] Kirtland KA, Li YF, Geiss LS, Thompson TJ. State-specific incidence of diabetes among adults–participating states, 1995–1997 and 2005–2007. MMWR Morb Mortal Wkly Rep. 2008; 57 (43): 1169–1173.

[5] Saygılı U, Kılıç SP. Determination of knowledge levels of nurses on insulin applications. International Journal of Diabetes and Endocrinology. 2017; 2 (4): 50-54. doi: 10.11648/j.ijde.20170204.11.

[6] International Diabetes Federation (IDF): Regional prevalence of diabetes. https://www.idf.org/our-network/regions-members/africa/welcome.html/ (2017). Accessed 22 October 2018.

[7] Avdal E, Kızılcı S. Concept analysis of diabetes and lack of self-efficacy nursing theory. Dokuz Eylül University School of Nursing Electronic Journal. 2010; 3 (3): 164-168.

[8] Shu AD, Myers MG, Shoelson SE. Pharmacology of endocrine pancreas. In: Golan DE, Tashjian Jr AH, Armstrong EJ, Armstrong AW. Editors. Principles of pharmacology the pathophysiologic basis of drug therapy. 2nd ed. New Delhi: Wolters Kluwer (India); 2008.

[9] Chrysoula D, Victoria A, Anna P. Assessment of insulin treatment-related knowledge among nurses in pediatric hospitals. IOSR Journal of Pharmacy. 2016; 6 (4): 20-25.

[10] Derr RL, Sivanandy MS, Bronich-Hall L, Rodriguez A. Insulin-related knowledge among health care professionals in internal medicine. Diabetes spectrum, Baltimore, United States of America. 2007; 20 (3): 177-185.

[11] Down S, Kirkland F. Injection technique in insulin therapy. Nursing Times. 2012; 108 (10): 20-21.

[12] Wakefield PL, Wilson MA. Enhancing nurses' knowledge regarding the complex care of hospitalized patients on insulin. Journal for Nurses in Professional Development. 2014; 30 (4): 174-180.

[13] Özcan Ş. Current practices in insulin therapy: recommendations for reducing insulin delivery failures. Journal of Education and Research in Nursing. 2007; 4 (2): 22-28.

[14] Edward Francis Small Teaching Hospital (EFSTH): Staff Record (Unpublished data). Banjul, The Gambia. 2018.

[15] Adhikari S, Poudel RS, Rajbanshi L, Shrestha S. Assessment of insulin injection practice of nurses working in a tertiary healthcare center of Nepal". Hindawi: Nursing Research and Practice. 2018; Article ID 9375067.

[16] Saho P. Factors Influencing the High Attrition of Nurses at Edward Francis Small Teaching Hospital" (Unpublished Masters Thesis). Presented in Partial Fulfilment of the Requirements for the Award of the Master of Science Degree in Nursing. University of the Gambia, Banjul, The Gambia. 2011.

[17] Mohammed MA, Hafez MZ. Nurses' knowledge, skill and attitudes toward insulin errors for diabetic critically ill patients. AAMJ. 2013; 11: 4.

[18] Findlow ML, McDowell RS. Determining registered nurses knowledge of diabetes mellitus- nurses knowledge. Journal of Diabetes Nursing. 2002; 6 (6): 170-175.

[19] American Diabetes Association (ADA): National standards for diabetes self-management education. Diabetes Care. 2009; 32: 13–61.

[20] Frid AH, Kreugel G, Grassi G. New Insulin Delivery Recommendations. Mayo Clinic Proceedings. 2016; 91 (9): 1231–1255.

[21] InDependent Diabetes Trust (IDDT): Storing insulin: looking after your insulin and injecting devices. Northampton, NN1 4XS, United Kingdom. 2018.

[22] Vimalavathini R, Gitanjali B. Effect of temperature on the potency & pharmacological action of insulin. Indian Journal of Medical Research. 2009; 130 (2): 166–169.

[23] Kedogo EK. Impact of insulin storage and administration technique on glycated heamoglobin among adult diabetic patients in kenyatta national hospital. A dissertation submitted in partial fulfillment for the requirements of the degree of master of pharmacy in clinical pharmacy of University of Nairobi. November 2015.

[24] Razzaq-Sheikh J. Policy for the safe administration of insulin. East Chesire NHS Trust. 2016. http://www.eastcheshire.nhs.uk/About-The-Trust/policies/I/Insulin%20%20Safe%20administration%20of%20-%20ECT2544.pdf. Accessed on December 31, 2018.

[25] Mushtaq MA. Study of insulin injection technique amongst the nursing staff". Pak J Med Sci. 2006; 22 (3): 310.