




Issue no: 1 | Vol no: 5 | July 2025: 13-25

Comparative Assessment of Knowledge, Attitude and Practice of Insulin Use amongst Diabetic Patients in Two Hospitals in Kenya

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Article History

Received: 2025-05-07

Accepted: 2025-06-08

Published: 2025-07-08

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Cite this article in APA

Adera, A. M., Guantai, E. & Okalebo, F. A. (2025). Comparative assessment of knowledge, attitude and practice of insulin use amongst diabetic patients in two hospitals in Kenya. *Editon consortium journal of research in medical and health sciences*, 5(1), 13-25. <https://doi.org/10.51317/ecjrmhs.v5i1.587>

Abstract

The aim of this study was to do a comparative assessment of knowledge, attitude and practice of insulin use amongst diabetic patients in two selected hospitals in Kenya. The knowledge, attitude and practice (KAP) around insulin use by patients is inadequately studied and poorly understood. A comparative, cross-sectional study design was adopted. Three hundred participants were interviewed between May and July 2023 at the pharmacies dedicated to the diabetes clinics in Kenyatta National Hospital (KNH) and Presbyterian Church of East Africa Kikuyu Hospital (PKH). Descriptive and inferential data analysis were done using STATA with the level of significance set at 0.05. Participants in both facilities demonstrated good knowledge and practice with notable interfacility differences in body mass index ($p < 0.001$), occupation ($p < 0.001$), family history of diabetes ($p < 0.001$), and a history of diabetes complications ($p < 0.001$). Higher knowledge (20 [17, 23]) and practice scores (3 [3, 3]) were achieved in PKH compared to KNH, and this difference was statistically significant ($p < 0.001$). The facility where one received care was the best predictor for both knowledge and practice on insulin, with PKH exhibiting better odds of good knowledge (aOR: 7.087, 95% C.I: 3.941, 12.744) and practice (aOR: 10.926, 95% C.I: 4.232, 28.21) compared to KNH. The attitude was favourable in both facilities. Insulin storage practices were poor in both facilities, and the frequency of replacing insulin needles was wanting. Better knowledge and practice of insulin use were demonstrated by PKH. Training is needed to improve selected practices. Possible explanations for interfacility differences should be explored.

Key words: Attitude, diabetes, insulin, insulin use, KAP.



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INTRODUCTION

Non-communicable diseases (NCDs) greatly contribute to the global burden of disease and significantly strain health systems. The World Health Organisation (WHO) estimates that up to 71 per cent of global deaths annually are due to non-communicable diseases. Diabetes is one such NCD, and Kenya reports a prevalence of 3.3 per cent, which is expected to rise to 4.5 per cent by 2025. Kenya has been identified as the East-African country with the highest deaths from diabetes.

Insulin is fundamental in diabetes management. Insulin administration is mostly by injections, which are usually administered daily and, in some cases, multiple times over 24 hours. Insulin has been acknowledged as an essential medicine by the WHO, but efforts to make it more accessible for all who need it remain inadequate. Appropriate knowledge, a good attitude, and proper practice in insulin use are essential components that ensure compliance in use and promote good clinical outcomes with a better quality of life and a longer life expectancy among diabetics. Consequently, all stakeholders are encouraged to work together in improving the KAP around insulin among diabetics.

Private sector studies around insulin use are limited. Notably, no systemic comparison on knowledge of patients regarding insulin use in the public and private faith-based sectors has been done. A KAP survey on insulin use in Kenya among diabetics in both the public and private faith-based sectors is therefore important to improve our body of knowledge around the use of insulin in the population in the context of a low or middle-income country (LMIC). Such studies are few not only in Kenya but in most LMICs, where the number of people affected by diabetes has been rising steadily.

This survey compared the KAP among diabetic patients who use insulin in two hospitals in Kenya's most populous counties of Nairobi and Kiambu. This study will advise on whether the current training offered to diabetics on insulin use assures good KAP and how such training can be improved. Inter-facility differences in patient KAP were highlighted.

LITERATURE REVIEW

Diabetes

Pathophysiology and Etiology of Diabetes

Diabetes is a series of metabolic disorders that lead to elevated plasma glucose levels (American Diabetes Association Professional Practice Committee, 2021). The elevation is observed upon measurement of glucose levels in a blood sample. The dysregulation in plasma glucose is secondary to disturbances in the hormone insulin (American Diabetes Association Professional Practice Committee, 2021). Insulin is responsible for the entry of glucose into the cells of the body, where it is utilised to provide energy. In individuals suffering from diabetes, the dysregulation in insulin can either be an absolute or relative lack of it. When there is an absolute lack of insulin, the individuals are described as having type 1 diabetes mellitus (T1DM) and a relative lack as type 2 diabetes mellitus (T2DM). T2DM is also associated with insulin resistance, where peripheral cells do not respond to insulin (American Diabetes Association Professional Practice Committee, 2021; Egan & Dinneen, 2019a). Other forms include gestational diabetes that occurs in pregnancy (American Diabetes Association Professional Practice Committee, 2021).

Epidemiology of Diabetes

Low- and middle-income countries (LMICs) have been worst hit by the burden of non-communicable diseases (NCDs) like diabetes. The prevalence of diabetes is on a steady rise, with the World Health Organisation (WHO) reporting a global rise from 4.7 per cent in 1980 to 8.5 percent in 2014, and an estimated 1.5 million deaths in 2012 were linked directly to diabetes (WHO, 2022b). These statistics are skewed towards LMICs, and Africa is expected to have 23.9 million cases by 2030 (WHO, 2022b). Kenya reports a prevalence of 3.3 per cent, which is expected to rise to 4.5 per cent by 2025 (WHO, 2022b).

Diabetes has had a significant economic impact worldwide, with an estimated USD 760 billion in 2019 marked as global direct costs of diabetes, and could increase by 8.6 per cent to reach USD 825 billion over the next decade (Adamjee & Harerimana, 2022). A Kenyan study further outlines the Kenyan total economic costs of diabetes, which were estimated at USD 372,184,585, equivalent to 10 per cent of Kenya's total expenditure on health (THE) or 0.4 per cent of the country's GDP (Adamjee & Harerimana, 2022). These

alarming reports call for a joint effort by all stakeholders to manage diabetes risk factors as well as establish diabetes and lower both the social and economic burden of diabetes worldwide, as envisioned in the WHO's Sustainable Development Goals. The risk factors for diabetes must be addressed to reduce the incidence of diabetes. Some modifiable risk factors include smoking, heavy alcohol consumption, obesity and sedentary lifestyle (American Diabetes Association Professional Practice Committee, 2021; WHO, 2022b).

Management of Diabetes

The use of herbal and complementary medicines in diabetes management has been widely reported in the literature. There have been claims of improvement in glycemic control when patients start on selected herbs (Shaheen et al., 2021). Usually, patients learn about the herbs from different sources, including television or through healthcare workers and relatives (Karaman et al., 2018). The use of herbs has been linked to positive feedback from other people who use them, the influence of herbalists in the community, the ease of access and availability of herbs and poor access to healthcare to obtain conventional medicines (Karaman et al., 2018). Individual factors that have been found to significantly influence the use of herbs in diabetics include gender, duration of disease and marital status, where more females, those having diabetes for 6-10 years and married people are the highest users, respectively (Karaman et al., 2018).

Different herbs have been shown to act by diverse mechanisms to achieve glycemic control. Some have components that stimulate insulin production while others increase target cell sensitivity to insulin, all in a joint effort to lower blood glucose levels (Shaheen et al., 2021). Reports indicate that patients may use more than one herb to manage diabetes, and the herbs may be used either alone or alongside conventional medicines (Karaman et al., 2018). Cinnamon, sage and onions are examples of such herbs (Karaman et al., 2018; Shaheen et al., 2021).

Diabetics should be encouraged to report use of herbal and complementary medicines to their healthcare providers to allow for proper evaluation and assessment of possible side effects, which may necessitate dose and/or regimen adjustments for optimal clinical outcomes (Karaman et al., 2018). Healthcare workers

should also be encouraged and reminded to obtain information on the use of herbs in diabetes management since most studies report that this is not common practice (Karaman et al., 2018).

Conventional management of diabetes involves the use of insulin in T1DM and the use of oral hypoglycemics with or without insulin in T2DM (Joint Formulary Committee, 2022).

Insulin is the mainstay in diabetes management for T1DM and some cases of T2DM (Joint Formulary Committee, 2022; WHO, 2022b). The prevalence of insulin use in the United States is 10.8 per cent within the first year of treatment initiation. (CDC, 2022) Such data in Africa and Kenya is not well documented and warrants more studies.

Sub-optimal management of diabetes leads to diabetic complications. These complications can either be macrovascular; affecting major blood vessels or microvascular; affecting smaller blood vessels (American Diabetes Association Professional Practice Committee, 2021; Shaheen et al., 2021). Effects on major blood vessels are associated with peripheral vascular disease and coronary artery disease, which affect smaller blood vessels and are associated with retinopathy, neuropathy and nephropathy (Shaheen et al., 2021). The importance of early diagnosis and management of diabetes with expert and individualised care can therefore not be overemphasised.

Insulin

Mechanism of Action of Insulin

Insulin is an endogenous hormone responsible for glucose homeostasis (Petersen & Shulman, 2018). The physiological processes targeted by insulin vary depending on the cell (Petersen & Shulman, 2018). The most significant cells studied for insulin's actions are the skeletal muscle cells, hepatocytes and adipocytes (Petersen & Shulman, 2018). In skeletal muscle and hepatocytes, insulin promotes glycogen and lipid synthesis while decreasing glucose production; in adipocytes, it reduces lipid breakdown and promotes lipid synthesis while increasing glucose transport (Petersen & Shulman, 2018). All these effects integrate to lower blood glucose levels and are considered the direct effects of insulin (Petersen & Shulman, 2018). Indirect effects of insulin have not been studied

exhaustively (Petersen & Shulman, 2018).

These physiological effects of insulin are exerted when it binds to the insulin receptor on target cells, and it has been shown that only one insulin molecule binds to one insulin receptor at a time (Petersen & Shulman, 2018). The binding of insulin activates a phosphorylation cascade, and numerous effectors are recruited at a molecular level to increase glucose uptake into target cells and concurrently initiate a negative feedback mechanism that terminates insulin's action (Petersen & Shulman, 2018). This process is repeated until blood glucose is controlled.

Adverse Effects of Insulin

The adverse effects of insulin have been associated not only with the pharmacological effects but also with the physical effects that result from frequent injections. In exerting its pharmacological effects, insulin is associated with hypoglycemia as the major side effect (Ngo et al., 2021; Spollett et al., 2016).

The physical side effects of insulin result from poor injection techniques, and the most frequent one is lipohypertrophy, which is believed to be due to a lack of rotation of insulin injection sites and re-use of insulin needles (Bahendeka et al., 2019; Spollett et al., 2016). Hyperpigmentation on insulin injection sites has also been highlighted and is a factor that may influence adherence to insulin therapy (Spollett et al., 2016).

Modifications of Insulin

Over the years, insulin has been modified to improve its pharmacokinetic and pharmacodynamic properties. It is classified based on pharmacokinetic profile into rapid, short, intermediate and long-acting insulins (Sharma et al., 2019). These insulins vary in their onset and duration of action as well as maximal plasma levels (Sharma et al., 2019). They are given as boluses or basal doses (Sharma et al., 2019).

These insulins are prepared by introducing modifications such as the addition of zinc ions or protamine and alteration of amino acids on the structure of insulin to delay absorption (Sharma et al., 2019). Other modifications on insulin formulations include premixed insulins which are pharmaceutical preparations of insulin that contain a mixture of two types of insulin where one is protaminated to prolong the duration of

action and reduce the doNeedle choice and proper training on the recommended injection technique are top recommendations to promote the proper use of insulin among diabetics and their caregivers (MOH, 2018). It is advised that training on insulin is done on initiation of treatment and repeated on subsequent clinical visits (Spollett et al., 2016).

Furthermore, the development of guidelines and in-house protocols to reinforce insulin use training among healthcare workers and educate diabetics should be encouraged (Bahendeka et al., 2019). Introduction of courses for healthcare workers is recommended to enrich their knowledge and skills on insulin and diabetes, thereby increasing the diabetes management workforce (Venkataraman et al., 2020).

A proper injection technique is important in ensuring proper insulin use (MOH, 2018; Ngo et al., 2021; Spollett et al., 2016). A proper technique is best achieved with continuous training by qualified healthcare professionals and practical demonstration to the patient until the technique is mastered, besides/alongside the use of print media (Gupta et al., 2021; Venkataraman et al., 2020).

Notably, some complications could arise from poor insulin injection techniques. Such complications can include an alteration in the pharmacological profile of insulin and compromised glycemic control due to lipodystrophy secondary to lack of rotation of injection sites, poor angling of insulin needles during injection or prolonged re-use of insulin needles (Bahendeka et al., 2019). Rotation of injection sites has been a long-standing recommendation and is all too familiar among healthcare providers and diabetics alike.

Conceptual Framework on Knowledge, Attitude and Practice of Insulin

There are three dependent variables, namely knowledge, attitude and practice.

Knowledge of Insulin Use

The knowledge around insulin use is broad and includes its mechanism of action, storage requirements, and its importance, as well as administration and consequences of poor administration (MOH, 2018; Ngo et al., 2021; Petersen & Shulman, 2018). Dosing recommendations and the results of poor adherence to prescribed doses,

along with meal timing and proper diet relative to insulin use and diabetes, are essential aspects to consider (MOH,

2018). Figure 1 summarises the scope and domains of insulin knowledge.

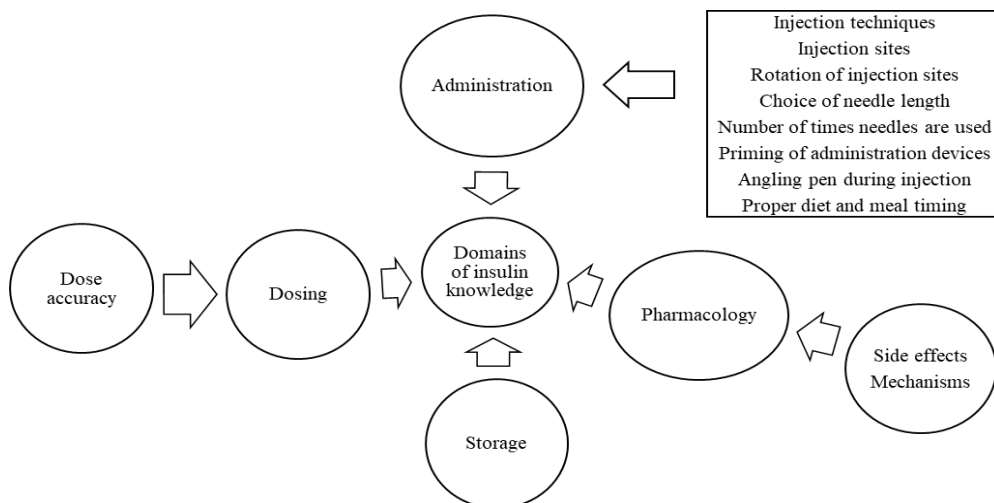


Figure 1: Scope and Domains of Insulin Knowledge

Studies have highlighted some factors, including age, employment status and the level of education, as being pivotal in determining the knowledge about insulin use (Jasper et al., 2014). The level of education being a significant contributor to knowledge of insulin use among patients was further emphasised by a Kenyan study (Mwangasha et al., 2021).

Attitude towards Insulin

In our context, attitude refers to one’s feelings, perception and beliefs towards insulin use (Abu Hassan et al., 2013). Attitude can be positive or negative. A positive attitude results from positive expectations, confidence in insulin use, the belief that insulin does not interfere with daily living and the hope that insulin can effectively cure diabetes (Abu Hassan et al., 2013; Hunt et al., 1997).

The components of a negative attitude towards insulin include anxiety about pain and needle phobia (Fox, 1995). Complaints of insulin use being a hassle and contributing to stigmatisation, meal restrictions and the causation of serious health problems all encourage a negative attitude toward insulin (Fox, 1995; Hunt et al., 1997). Attitude is measured using the discrete choice models, where a questionnaire is prepared with a given

set of alternatives to assess the attitude based on participants’ responses (Casciano et al., 2011).

A qualitative approach that involves the use of in-depth interviews with individual participants as well as focus group discussions has been used to measure attitude (Abu Hassan et al., 2013). The latter seemed more effective when the groups were homogenous in terms of educational status, and it was reported that better and deeper discussions were achieved, contributing to a positive attitude towards insulin (Abu Hassan et al., 2013). The attitude toward insulin pens can also be assessed by observing participants as they inject insulin rather than using questionnaires (Tosun et al., 2019).

Practice towards Insulin Use

Practices can be proper or improper. Some of the practices that stand out and are considered improper entail using insulin past the expiry date, failure to rotate injection site, massaging the skin after injection, use of needles with an inappropriate length and failure to change needles after each injection and failure to eject any trapped air before injection (Tosun et al., 2019). Maintaining the proper penetration angle during injection, pinching the injection site during injection as determined by the needle size, choosing the correct dose of insulin, and adequate

positioning of insulin vials in the refrigerator are all considered good practice and are encouraged (Bahendeka et al., 2019; Tosun et al., 2019).

Many patients who are initiated on insulin are reported to have poor insulin use skills, which improve over time as they get more comfortable with insulin administration and experience the benefits of its use (Abu Hassan et al., 2013). A contrary finding reported that the more a patient uses insulin and the more the number of insulin injections per day, the poorer their practice toward insulin gets (Tosun et al., 2019).

The need for proper patient education to improve their insulin injection technique is unmet and would go a long way in improving diabetes care if it is implemented strategically (Bahendeka et al., 2019; Venkataraman et al., 2020). A study found that the longer a patient is on insulin and the higher the frequency of insulin injections they should administer in a day, the poorer their practice on insulin pen use gets, necessitating continuous retraining of insulin pen users (Tosun et al., 2019).

Regarding practice, the EADSG guidelines give recommendations and discuss the maintenance of the cold chain, especially during the use of insulin in LMICs

where the majority of patients may not have a refrigerator (Bahendeka et al., 2019). Patients are advised to avoid storing open vials immersed in water. (Bahendeka et al., 2019). The guidelines further touched on injections, advising patients to inject themselves with insulin after a meal to reduce the risk of hypoglycemia, and that patients should seek nutritional advice on diet vis-à-vis diabetes (Bahendeka et al., 2019).

Healthcare workers were advised to observe their patients directly, especially during the administration of their first few insulin injections, to help address the patients' fears and ensure proper mastery of a good injection technique (Bahendeka et al., 2019). The EADSG guidelines also looked at care of injection sites, listing multiple steps that pertain to daily injection site care, including visual inspection and cleaning (Bahendeka et al., 2019). Suggestions on how to safely travel with insulin and various insulin delivery devices, as well as safe disposal of needles and syringes, were outlined (Bahendeka et al., 2019). The proper insulin injection techniques were demonstrated stepwise, and needle size selection was discussed (Bahendeka et al., 2019) to support good practice toward insulin. Figure 2 outlines the determinants of knowledge, attitude and practice of insulin use.

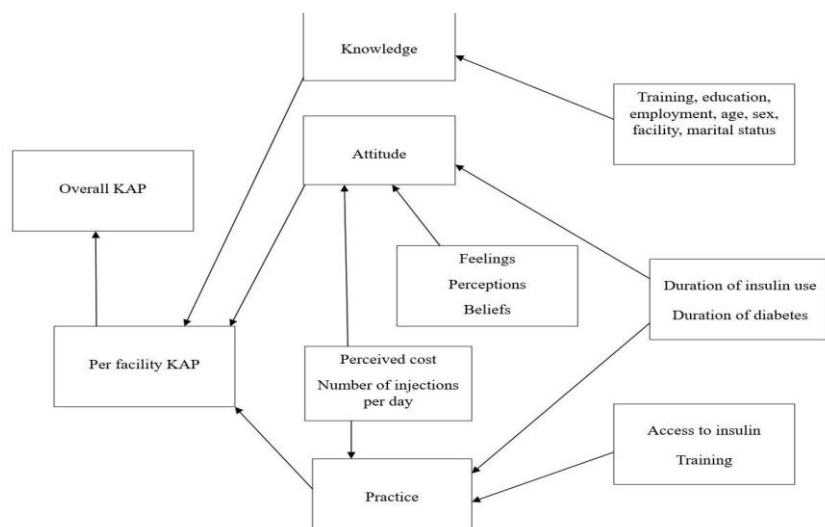


Figure 2: Determinants of Knowledge, Attitude and Practice of Insulin Use

METHODOLOGY

Study Design and Setting

A comparative, cross-sectional study design was adopted and conducted between May and July 2023 at the

pharmacies dedicated to serving the diabetic clinics in Kenyatta National Hospital (KNH) and Presbyterian Church of East Africa Kikuyu Hospital (PKH). Kenyatta National Hospital was selected because it is the largest

teaching and referral hospital in Eastern and Central Africa and therefore should represent optimal practice in patient education. It is located in the capital city, Nairobi. Presbyterian Church of East Africa Kikuyu Hospital (PKH) is located in a neighbouring, densely populated county and is a faith-based hospital that caters to a rural-urban population.

These two hospitals were chosen to represent the public and faith-based sectors, respectively, and were picked from the two most populous counties in Kenya. These hospitals serve a wide population both inside and outside the counties, thus assuring heterogeneity in the population served.

Study Population

Participants were included if they were adults aged 18 years or older, with a history of diabetes, who were using insulin and were served at the pharmacies dedicated to the diabetic clinics in the two facilities. They were also required to give informed consent to participate. Participants were excluded from the study if they did not communicate effectively in English or Kiswahili.

The sample size was determined using Florey's formula. It was estimated that 60 per cent of participants would exhibit good Knowledge, Attitudes, and Practices (KAP), with a 10 per cent difference anticipated between the two study sites. This calculation resulted in an initial sample size of 137 participants per site. This number was increased by 10 per cent to account for potential errors, leading to a final sample size of 150 participants per site. The participants were recruited using consecutive sampling.

Patients waiting for their prescriptions to be filled at the pharmacies were approached in the order in which they presented themselves. Those who met the eligibility criteria were requested to participate in the study. Those who chose to participate in the study were interviewed in a private space that was set aside. The informed consent form was read to them in the language they were comfortable with, either English or Kiswahili.

Data Collection

A structured questionnaire was administered by the researcher or trained research assistants until the estimated sample size was achieved. The questionnaire

included 21 knowledge-based questions about insulin types, dosing, injection sites, and techniques, one question on attitude, and five practice-related questions on insulin handling and storage.

Dependent Variable

The overall KAP scores.

Independent Variable

The independent variables included patient characteristics like age, sex, level of education, occupation, marital status, family history of diabetes, duration of diabetes, duration of insulin use, and primary care facility.

Data Analysis

The data was fed into Microsoft Excel and coded before being transferred into STATA™ version 14 for analysis. Categorical variables were summarised as counts and percentages. The Shapiro-Wilk test was used to test for normal distribution. Numeric variables were summarised as the median and interquartile range if they were not normally distributed; normally distributed variables were summarised as the mean and standard deviation. Pearson's Chi-square test was used for inferential analysis to compare the two facilities. Logistic regression analysis was used to identify risk factors for the knowledge and practice scores. The level of significance was set at 0.05.

A patient was considered to have good knowledge with a score of ≥ 18 out of 28, good practice with a score of ≥ 3 out of 5, and a good attitude based on their agreement or disagreement with specific statements.

Ethical Considerations

Ethical approval was granted by the Kenyatta National Hospital-University of Nairobi Ethics Review Committee under approval number P16/01/2023, as well as a research license from the National Commission for Science and Technology. Informed consent was obtained from the study participants before engagement in the study. Privacy was assured by carrying out the interviews in a private designated area. Participants were informed that they were free to drop out of the study at any point without fear of victimisation.

The data was stored under password protection with access restricted to the researcher and research

assistants. All patient identifiers were excluded. After collecting the data, patients were educated on proper insulin use.

RESULTS AND DISCUSSION

Patients’ Sociodemographic Characteristics and Clinical Data

Table 1: Comparison of the Sociodemographic Characteristics of Diabetic Patients in Kenyatta National Hospital and PCEA Kikuyu Hospital

Variable	Categories in the variable	KNH n(%)	PKH n(%)	Total	P-value
Gender	Male	53 (35.3)	53 (35.3)	106	1.000
	Female	97 (64.7)	97 (64.7)	194	
Age (years)	≤62	91 (60.7)	75 (50.0)	166	0.063
	>62	59 (39.3)	75 (50.0)	134	
BMI	Underweight	1 (0.7)	0 (0.0)	1	<0.001
	Normal	8 (5.3)	12 (8.0)	20	
	Overweight and obese	19 (12.7)	122 (81.3)	141	
	Not available in the file	122 (81.3)	16 (10.7)	138	
Marital status	Single	22 (14.7)	13 (8.7)	35	0.035
	Divorced	0 (0.0)	3 (2.0)	3	
	Widowed	26 (17.3)	40 (26.7)	66	
	Married	102 (68.0)	94 (62.7)	196	
Occupation	Unemployed	29 (19.3)	54 (36.0)	83	<0.001
	Employed	8 (5.3)	16 (10.7)	24	
	Self-employed	58 (38.7)	68 (45.3)	126	
	Retired	55 (36.7)	12 (8.0)	67	
Smoking status	Smoker	2 (1.3)	1 (0.7)	3	0.562
	Non-smoker	148 (98.7)	149 (99.3)	297	
Alcohol ingestion in the past 1month	Ingested alcohol	3 (2.0)	0 (0.0)	3	0.082
	Did not ingest alcohol	147 (98.0)	150 (100.0)	297	
Level of education	No education/illiterate	12 (8.0)	12 (8.0)	24	0.102
	Primary level	55 (36.7)	37 (24.7)	92	
	Secondary level	58 (38.7)	77 (51.3)	135	
	College university or and above	25 (16.6)	24 (16.0)	49	

Table 1 summarises the sociodemographic characteristics of patients in the two study sites. Of all the independent variables assessed in the study, there was a statistically significant difference in Body Mass Index (BMI) ($p < 0.001$), marital status ($p = 0.035$) and occupation ($p < 0.001$) between patients in KNH and PKH. Notably, 81.3 per cent of patients in KNH did not have their BMI measurement on file, while the same percentage (81.3 per cent) in PKH had their BMI on file.

Most patients whose BMI was available were classified as overweight or obese.

Overall, the majority of the patients (65.3%) were married, with a higher percentage in KNH (68.0% in KNH versus 62.7% in PKH). Further, most patients were self-employed (42%), with more self-employed participants in PKH compared to KNH (45.3% versus 38.7%).

Table 2: Comparison of the Clinical Characteristics of Diabetic Patients in Kenyatta National Hospital and PCEA Kikuyu Hospital

Variable	Categories in the variable	KNH n(%)	PKH n(%)	Total	P-value
Family history of diabetes	Present	90 (60.0)	120 (80.0)	210	<0.001
	Absent	60 (40.0)	30 (20.0)	90	
Glycemic control	Good	77 (51.3)	87 (58.0)	164	0.246
	Poor	73 (48.7)	63 (42.0)	136	
History of diabetes complications	Present	47 (31.3)	105 (70.0)	152	<0.001
	Absent	103 (68.7)	45 (30.0)	148	
Duration participant has had diabetes (months)	1-60	42 (28.0)	35 (23.3)	77	0.308
	61-120	24 (16.0)	39 (26.0)	63	
	121-180	26 (17.3)	26 (17.3)	52	
	181-240	24 (16.0)	21 (14.0)	45	
	>240	34 (22.7)	29 (19.3)	63	
The duration the participant has been on insulin (months)	1-60	64 (42.7)	71 (47.3)	135	0.210
	61-120	31 (20.7)	37 (24.7)	68	
	121-180	21 (14.0)	10 (6.7)	31	
	181-240	16 (10.7)	19 (12.7)	35	
	>240	18 (12.0)	13 (8.7)	31	

Table 2 compares the clinical characteristics of patients in the two facilities. There was a statistically significant difference in the family history of diabetes and the prevalence of diabetes complications across facilities. More patients in PKH had a family history of diabetes (80% versus 60%, $p < 0.001$) and reported having suffered from diabetes complications (70% versus 31.3%, $p < 0.001$). There was no interfacility difference in glycaemic control and the duration of diabetes and insulin use.

Knowledge on Insulin Use among Diabetic Patients in Kenyatta National Hospital and PCEA Kikuyu Hospital

Patients at PKH had better knowledge compared to KNH patients (72% versus 28%, $p < 0.001$), and the median of the knowledge score at PKH was 20 compared to KNH at 15. Figure 1 gives a summary of the knowledge score.

Knowledge score was binarised at its median of 18, and logistic regression was run. In the most parsimonious model, patients in PKH were 7 times more likely to have good knowledge when compared to patients in KNH (aOR: 7.087, 95% C.I: 3.941,12.744).

The negative association between age and knowledge showed that older people had lower levels of knowledge (aOR: 0.971, 95% C.I: 0.952,0.991). A strong positive association was noted between having diabetic complications and knowledge (aOR: 2.009, 95% C.I: 1.105,3.653) as well as knowledge and one’s level of education (aOR: 1.700, 95% C.I: 1.198,2.412).

Attitude towards Insulin Use among Diabetic Patients in Kenyatta National Hospital and PCEA Kikuyu Hospital

The majority of the patients were comfortable with self-administration of insulin with PKH (n=134, 89%)

recording higher numbers than KNH (n=125, 83.3%).

Practice around Insulin Use among Diabetic Patients in Kenyatta National Hospital and PCEA Kikuyu Hospital

Overall, PKH patients (n=143, 95.3%) had good practices compared to KNH (n=96, 64%), this finding was statistically significant (p<0.001).

Patients in PKH were more likely to report that they knew how to measure insulin doses by themselves compared to KNH (95.3% versus 86.7%, p=0.009). Nearly all patients in PKH reported checking the expiry date on insulin before use (98.7% versus 74.0%, p<0.05) and monitoring their blood glucose levels at home (98.7% versus 89.3%, p = 0.001) when compared to KNH. Table 3 outlines these findings on the practice around insulin use among patients in KNH versus PKH.

Table 3: Comparison of the Practice around Insulin Use among Diabetic Patients in Kenyatta National Hospital and PCEA Kikuyu Hospital

Practice question		KNH n(%)	PKH n(%)	Total	P-value
Q1: Do you know how to measure your dose of insulin by yourself? (Yes/No)	Yes	130 (86.7)	143 (95.3)	273	0.009
	No	20 (13.3)	7 (4.7)	27	
Q2: Do you check the expiry date on your insulin before using it? (Yes/No)	Yes	111 (74.0)	148 (98.7)	259	<0.05
	No	39 (26.0)	2 (1.3)	41	
Q3: How do you keep your insulin during use, that is, after opening it?	Good practice	16 (10.7)	9 (6.0)	25	0.144
	Poor practice	134 (89.3)	141 (94.0)	275	
Q4: How many times do you change your insulin needles?	Good practice	14 (9.3)	15 (10.0)	29	0.845
	Poor practice	136 (90.7)	135 (90.0)	271	
Q5: Do you monitor your blood	Yes	134 (89.3)	148 (98.7)	282	0.001

glucose levels at home? (Includes visiting local HCP at their locality to check the blood glucose levels) (Yes/ No)	No	16 (10.7)	2 (1.3)	18	
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The practice score was binarised at its median of 3, and logistic regression was run. In the most parsimonious model, patients in PKH were 10 times more likely to have good practice when compared to patients in KNH (aOR: 10.926, 95% C.I: 4.232,28.21). Further, those with good BMI were twice as likely to have good practice (aOR: 2.012, 95% C.I: 1.019,3.974). The negative association between age and practice showed that older people had poorer practices when using insulin (aOR: 0.969, 95% C.I: 0.945,0.994). A strong positive association was reported between one's level of education and practice (aOR: 1.798, 95% C.I: 1.204,2.687) as well as practice and one's duration of insulin use (aOR: 1.006, 95% C.I: 1.002,1.010).

Discussion

The facility where one receives care stood out as the best predictor of knowledge on insulin, however, few KAP surveys compare knowledge on insulin between facilities. PKH patients may have had better knowledge due to their mode of training. Organised training at diabetic clinics, as in PKH, may be more impactful than one-on-one sessions with physicians, as in KNH. Most patients in our study had good knowledge, a finding that aligned with other studies [4,10]. Good knowledge has been attributed to the level of education by both our study and others [10,11], besides the facility where one receives care. Contrary to our findings, some studies found poor knowledge among participants regarding insulin use [6,11]. This was attributed to the facility where one receives care, with claims that accessibility and the facility's resources may influence insulin use knowledge [6]. These stand out as factors that can be investigated in future studies.

Further, our study ranked the level of education as the second most influential predictor of knowledge on insulin and other studies concurred that it is a good predictor [5,10,11]. Our study also identified a positive association between diabetic complications and knowledge of insulin. Few studies have explored this association, and it stands out as a possible area for future

research. Both our study and that by Gupta et al. (2021) reported that the majority of study participants were comfortable with insulin self-administration [4]. The reasons for this observation were not explored and form a basis for future research.

Our findings of good practice around insulin use were collaborated by other studies, which attributed it to comprehensive diabetes care that focuses on patient information and education [6]. Some studies also reported poor practice [10]. Much like other studies, our study reported good practices on proper self-measurement of insulin [4] and checking expiry dates on insulin before administration [4,12]. Suboptimal storage of insulin [12,13] and the frequency of insulin needle change were areas of poor practice, as corroborated by other studies [13]. The majority of patients continued keeping their insulin in the fridge and other cold chain systems even during use, contrary to the recommendations by both studies and guidelines to store in-use insulin at room temperature [3,9,13]. Some studies also reported good practice around insulin storage [4].

Our study reported a significant number of patients deviated from the recommended practice of changing their insulin needles after a single use. Instead, they continued using the same needle for more than five uses. This was observed in other studies as well [10,14]. The facility where one receives care stood out as the best predictor of practice around insulin, however, there are few KAP surveys that compare practice between facilities. Other predictors, like the duration of insulin use, were also reported by other studies [13].

Limitations of the Study

There is a risk of recall bias, especially for patients who have been on insulin for a long time. This was managed by training on proper interview skills with further probing and the use of questions that would prompt the participants' memories. There was a potential for response bias in some of the questions. This was

mitigated by carefully crafting the questions in an unbiased manner and posing them in a way that ensured the participants felt comfortable. They were also reassured of a safe environment and the guarantee of anonymity.

The assessment of attitude, particularly in diabetes patients, was insufficient. Therefore, the findings should be considered in this context, and future research is encouraged to comprehensively examine all three aspects of Knowledge, Attitude, and Practice (KAP).

CONCLUSION AND RECOMMENDATION

Conclusion: The facility where one receives care was identified as the best predictor for both knowledge and practice towards insulin use. In both facilities, there was a favourable attitude towards insulin use and adequate practice. Better knowledge was reported in PKH compared to KNH. There is a high prevalence of diabetes in Kenya, and insulin is fundamental in diabetes management. The KAP around insulin use is inadequately studied, furthermore, no systemic comparison of inter-sector and interfacility KAP has been reported in Kenya. The training around insulin storage and needle change is inadequate and requires emphasis. Identification of interfacility and inter-sector

differences in KAP by our study will guide future studies into the reasons why such differences were observed. Predictors of KAP around insulin use are not well studied, and the facility where one receives care stands out as a significant factor in the determination of KAP.

Recommendations: This study makes the following recommendations: To promote the use of insulin pens for diabetics to enjoy their full benefits, the Ministry of Health and other healthcare stakeholders should formulate and implement policies to address the purported high cost of insulin pens. With more insulin pen users in PKH and these insulin pen users having acquired their knowledge on the pen from organised clinic training, this can be considered as a possible avenue to be explored further in insulin use training, as well as insulin pen awareness.

Acknowledgements

The Kenyatta National Hospital, Presbyterian Church of East Africa - Kikuyu Hospital, and the University of Nairobi for granting me the opportunity to learn and undertake this research.

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