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Assessing and Comparing Knowledge, Attitudes, and Use of Insulin Pens in Public and Private Hospitals in Kenya

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Abstract
This study assessed and compared the knowledge, attitude and Practice of insulin use and devices among diabetic patients and physicians in the Kenyatta National Hospital (KNH) diabetic clinic and Presbyterian Church of East Africa Kikuyu Hospital (PKH) diabetic clinics. A multi-site, cross-sectional study design was adopted with the use of questionnaires to gather data. The sample size was determined using the Cochran formula, and a total of 300 participants were included in the study through consecutive sampling. The study was conducted at the pharmacies dedicated to serving the diabetic clinics in KNH and PKH for 3 months each, or until the estimated sample size was attained. Data was coded and cleaned using Microsoft Excel and analysed using STATA version 14. Descriptive and inferential data analysis were done with the level of significance set at 0.05. The knowledge and practice scores were dichotomised, and logistic regression was utilised to assess the predictors of knowledge and Practice. More PKH patients knew about insulin pens compared to KNH patients (82.7% versus 42.7%). More PKH patients were on insulin pens (40.0% versus 22.7%). Almost all PKH patients primed their pens before use (97% versus 62%). Both facilities had poor practices among diabetics, which included a low frequency of replacing insulin needles (PKH 72% versus KNH 77%). Overall, physicians in both facilities showed good knowledge, attitude, and practice toward insulin pens. Patient attending PKH demonstrated better knowledge and Practice towards insulin pens compared to KNH. Training is needed to address poor practices.

Key terms: Diabetes, diabetes education, insulin, insulin pens, KAP.

1.0 INTRODUCTION

In diabetes management, insulin is a fundamental agent for the control of blood glucose levels. Insulin administration is mostly by injection to prevent its degradation in the body by enzymes in the gut. These injections are usually administered daily and, in some cases, multiple times over 24 hours (Bahendeka et al., 2019). Insulin has been acknowledged as an essential medicine by the WHO, and efforts to make it more accessible for all who need it remain inadequate. Lack of proper policies around insulin supply and diabetes care, uncontrolled market prices of insulin and inadequately defined insurance cover for insulin are among the factors that significantly cripple access to insulin.

A study that focused on T2DM patients projected the global consumption of insulin to rise to 663.7 million 1000 IU vials by 2030, but only 7.4 per cent of patients who should use insulin would be able to access it if accessibility to insulin is not addressed (Basu et al., 2019). Insulin administration has been studied and improved to make it more convenient and agreeable for diabetics. Developments including the use of insulin vials and special insulin syringes and the more recent insulin pens, which are further being advanced into smart insulin pens to maximise their benefits, have been explored (Kesavadev et al., 2020).

Studies have been done to demonstrate the benefits of insulin pens over other insulin administration methods. The insulin pens have been lauded for their ease of use, storage and transport as well as better dose accuracy (Bahendeka et al., 2019; Kesavadev et al., 2020; Magwire, 2011). These benefits have translated to clinical improvements with diabetics who use insulin pens showing better glycemic control, a lower risk of hyperglycemia and a better quality of life (Magwire, 2011). The benefits they confer have encouraged physicians to recommend their use, and patients prefer them over other methods of administration. (Magwire, 2011).

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 as shown by multiple studies (Gupta et al., 2021; Sunny et al., 2021; Venkataraman et al., 2020). Consequently, all stakeholders are encouraged to work together in improving the KAP around insulin among both the diabetics and their caregivers.

This survey established the KAP among diabetic patients and practitioners who use and prescribe insulin in two hospitals in Kenya's most populous counties of Nairobi and Kiambu. Such studies are few not only in Kenya but in most LMICs where the number of people affected by diabetes has been rising steadily (WHO, 2022b).

Management of diabetes, especially T1DM, depends on insulin. Good knowledge of insulin builds a good attitude towards it, which promotes good Practice in the use of insulin. Rotation of injection sites has been a long-standing recommendation and is all too familiar among healthcare providers and diabetics alike (Bahendeka et al., 2019). A proper insulin injection technique is paramount (Spollett et al., 2016). Some challenges faced in achieving proper technique include needle reuse and injection through clothing (Spollett et al., 2016). A proper technique can only be best achieved with continuous training by qualified healthcare professionals and practical demonstration by the patient until the technique is mastered (Gupta et al., 2021).

Private sector studies around insulin use and pens are limited. Notably, no systematic comparison of the knowledge of patients on insulin use and pens in the private and public sectors has been done. A KAP survey on insulin and use of pens in Kenya among diabetics and insulin prescribers in both the public and private sectors is therefore important to improve our body of knowledge around the use of insulin in the population in the context of an LMIC. It will help advise on whether training on insulin use conducted among healthcare workers and passed down to diabetics is impactful. This study evaluated the Knowledge, attitude and Practice around insulin pens and how they influence their adoption in the Kenyan population.

2.0 LITERATURE REVIEW

Insulin

Mechanism of Insulin Action.

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.

Insulin Delivery Devices

Over the years, the devices used to administer insulin have evolved to adapt to the needs of the users. Currently, there is the use of insulin syringes and needles, pumps and pens to administer insulin, while other devices such as the artificial pancreas and jet injectors are still under development and improvement (Kesavadev et al., 2020).

The insulin syringes and needles have been used for insulin administration for a very long time and remain a mainstay in LMICs (Bahendeka et al., 2019). There have been progressive marked improvements in their bore size and length to improve their efficiency in insulin delivery (Kesavadev et al., 2020). As it stands, needles with small bores and a shortened length are most preferred (Kesavadev et al., 2020). Some challenges associated with insulin syringe and needle use include inaccurate dosing of insulin, a long training time, adverse psychological effects and inconvenience in carrying syringes around and preparing them for use (Kesavadev et al., 2020).

Insulin pumps are special delivery devices that continuously deliver insulin to the user and are programmed to mimic the patient's insulin needs at basal and post-prandial periods (Kesavadev et al., 2020). They have advantages such as more accurate insulin dosing that reduces the incidence of

hypoglycemia, and disadvantages such as operating the device, which can interfere with insulin delivery (Kesavadev et al., 2020). The use of insulin pumps is on a steady rise among T2DM patients (Kesavadev et al., 2020). Another common delivery device whose use is on the rise is the insulin pen. This study focused on insulin pens and their adoption in Kenya.

Insulin Pens

Insulin pens are insulin delivery devices that are made up of an insulin cartridge, a disposable needle and an incremental dosing unit (Kesavadev et al., 2020). Its basic operation involves fitting the needle onto the pen device over the cartridge, turning the dosing unit to obtain the required dose of insulin, followed by injection to administer the insulin. Where the insulin cartridge is replaceable, the device is referred to as a reusable insulin pen and where it is not, a disposable insulin pen (Kesavadev et al., 2020).

The use of these pens has documented advantages such as simplicity in use, increased dosing accuracy, reduced perception of pain and greater convenience in insulin delivery (Kesavadev et al., 2020; Magwire, 2011). Pens are far more discreet compared to the insulin syringe and vials (Bahendeka et al., 2019; Magwire, 2011).

The notable features of the insulin pens that contribute to their benefits include making them slimmer, more discreet and ergonomic with clear dose magnification windows that have a dose arrow and audible click sound per unit dialled (Kesavadev et al., 2020). Pens with half-unit increments are also available (Kesavadev et al., 2020).

Slim and discreet designs improve on the convenience of insulin administration and transport by reducing the social discomfort and stigma often associated with insulin use (Bahendeka et al., 2019; Kesavadev et al., 2020). Ergonomic designs reduce the physical effort used in insulin administration (Bahendeka et al., 2019; Kesavadev et al., 2020). Dose magnification windows on the dosing unit, as well as audible clicks per unit of insulin dialled, help patients select their insulin doses more accurately (Kesavadev et al., 2020), even in advanced disease, which is usually associated with complications that impair vision (WHO, 2022b). Having insulin pens that can measure half-unit doses further increases the accuracy of insulin dosing, allowing for measurement of much smaller doses during insulin use (Kesavadev et al., 2020).

Smart insulin pens are advanced insulin pens that have a memory function which keeps a record of important factors such as previous doses of insulin administered, time of last insulin administration and time to next insulin administration (Kesavadev et al., 2020). Furthermore, some smart pens have universal serial bus (USB) and Bluetooth provisions to allow for data transfer from the device to any other device (Kesavadev et al., 2020). When exported, these smart pen records can be used to generate summary reports on insulin use over a given period (Kesavadev et al., 2020). These features put diabetics in a better position to control and monitor their blood glucose.

Insulin pen use is affected by their perceived higher cost compared to the syringe and needle in LMICs like the East African region (Bahendeka et al., 2019). The lack of insurance coverage for insulin pens in some countries reduces their use and availability (Kesavadev et al., 2020). Strikingly, short-term use of pens seems expensive, especially in LMICs, but long-term use tends to be cost-effective (Kesavadev et al., 2020). This is because insulin pens offer more accurate insulin dosing and easy insulin administration, thereby

lowering the incidence of complications related to both insulin administration and uncontrolled blood glucose (Kesavadev et al., 2020), which would otherwise be expensive to manage.

Empirical Review of Literature

Knowledge of Insulin Use

Multiple studies, both in Africa and beyond, report a need to improve patients' knowledge of insulin. Consulting with a healthcare worker on insulin use and long-term use of insulin were reported as some of the factors that greatly contributed to knowledge on insulin use and insulin pen use by a study done in Vietnam in an outpatient centre (Ngo et al., 2021). However, this knowledge remained inadequate in this study population (Ngo et al., 2021). The level of education, economic status, period of use of insulin and profession were major contributors to knowledge of insulin use as determined in a tertiary hospital-based study (Sunny et al., 2021).

A few studies in India reported a need to improve knowledge of insulin. One study, which was done at a medical college and research institute, highlighted the poor knowledge and attitude of diabetics towards insulin use, stating that most patients did not know the adverse effects associated with insulin (Venkataraman et al., 2020). Another study in a tertiary care hospital reported a gap in the knowledge about insulin, especially the types of insulin, insulin injection sites and the adverse effects of insulin (Gupta et al., 2021). The need to know the different injection sites and to rotate between them was also considered a significant knowledge gap by a study in Turkey (Tosun et al., 2019).

Regarding insulin pens, a knowledge gap was reported in that patients do not know the proper length of insulin needle to use (Tosun et al., 2019). In a Kenyan study, the duration of clinical Practice and professional cadre were reported to improve insulin knowledge among healthcare workers (Karara et al., 2016). Improved patients' knowledge of insulin reduces the occurrence of adverse effects associated with insulin, the most common being hypoglycemia and lipodystrophy and may contribute to a better attitude towards insulin (Ngo et al., 2021). Compliance with insulin therapy, secondary to better knowledge, increases the life expectancy in diabetic patients. Better compliance is evident in patients who have had advice from a healthcare professional (Ngo et al., 2021).

Knowledge of insulin use can be obtained from multiple sources, but most patients rely on their healthcare providers and consider the information they get from them credible (Bahendeka et al., 2019). Knowledge of insulin handling and proper use greatly influences the patients' attitude (Bahendeka et al., 2019).

Attitude Towards Insulin Use

Poor attitude towards insulin remained a significant finding (Gupta et al., 2021). A study reported the level of education, economic status, period of use of insulin and profession to contribute to the attitude towards insulin and overall, the KAP score (Sunny et al., 2021). Studies affirmed that the attitude towards insulin needed improvement, and it is agreed that a negative attitude is transient and modifiable (Bahendeka et al., 2019). Patients with a negative attitude reported fearing that insulin was harmful and fearing adverse effects such as hypoglycemia (Gupta et al., 2021).

Practice with Regard to Insulin Use

Some studies have highlighted poor practices in the use of insulin. Two studies done in the endocrinology outpatient departments of two tertiary hospitals demonstrated poor injection techniques and the use of

unsafe insulin that was either clumped or expired (Gupta et al., 2021; Tosun et al., 2019). Research conducted within endocrinology outpatient clinics at two teaching hospitals showed failure to prime pens, remove insulin needles from the pen post injection and failure to hold the pen in place for a few seconds after injection as practice gaps (Ngo et al., 2021; Tosun et al., 2019). It was also noted that most patients had poor Practice of massaging the injection site after insulin administration (Tosun et al., 2019). Further, as determined by a study done at a diabetes screening centre, some patients were not consistent with their insulin intake due to cost implications associated with insulin and administration devices (Jasper et al., 2014).

3.0 METHODOLOGY

This multi-site, cross-sectional study was conducted at the diabetic clinic pharmacies of Kenyatta National Hospital (KNH) and P.C.E.A Kikuyu Hospital. 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, whose health facilities serve a wide population both inside and outside the counties. This assures heterogeneity in the population served. The study targeted adults aged 18 or older with diabetes using insulin and physicians prescribing insulin at these clinics, requiring informed consent and effective communication in English or Kiswahili. The sample size was determined using Cochran's (1977) formula.

Using the proportion of the population expected to have good knowledge yielded the largest target sample size of 296. In comparison, when considering the proportions of the population expected to have a good attitude and Practice, the estimated sample sizes were 255 and 5, respectively. Consequently, the estimated target sample size for the knowledge domain was used as the overall sample size and was divided equally between the two facilities. The diabetic patients were stratified by facility and sampled on a 1:1 basis. At least 150 participants were identified and recruited at each study site using consecutive sampling. Given a low prescriber-to-patient ratio, prescribers were not sampled; rather, all prescribers in the study sites were informed about the study and those Individuals who fulfilled the eligibility requirements and agreed to participate in the study were included.

Data was collected by the use of questionnaires. For patients, the approved patient questionnaire was administered by the researcher or trained research assistants until the estimated sample size was achieved. For physicians, the approved physician questionnaire was issued and collected at the end of the clinic day. The knowledge, attitude and Practice scores were computed using the score cards. Using STATA version 14 for analysis, the data were summarised as counts and percentages, and the Pearson's Chi square test was utilised to compare the two facilities. For diabetic patients, knowledge and Practice were binarised at their respective medians, 18 and 3 marks. For physicians, binarisation was done at 4 and 2 marks for knowledge and Practice, respectively. Logistic regression analysis was done to show the association between the independent variables and knowledge as well as Practice. The level of significance was set at 0.05 throughout the analysis.

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.

4.0 RESULTS AND DISCUSSION

Patients' Knowledge, Attitude and Practice towards Insulin Pens

Knowledge of Insulin Pens Among Diabetic Patients in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital

Almost double the number of diabetic patients in PKH knew about insulin pens compared to KNH (n=124, 82.7% versus n=64, 42.7%). Similarly, the number of PKH patients who use pens was almost double that of KNH (40.0% versus 22.7%). More patients at PKH had used insulin pens longer (≥1year) compared to KNH (78.3% versus 58.8%). Whether or not the patients were using insulin pens, most KNH patients found out about them from healthcare workers, compared to PKH, where they found out through organised training at the clinic. **Table 1** summarises these findings between KNH and PKH.

Table 1: Summary of patients' knowledge about insulin pens in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital

Variable		Categories in the variable	KNH n(%)	PKH n(%)	Total	P-value
Know about an insulin pen		Know about insulin pens	64 (42.7)	124 (82.7)	188	**<0.001**
Use an insulin pen		Use insulin pens	34 (22.7)	60 (40.0)	94	**0.001**
Reasons for not using pens despite knowing about them		High cost of pens	19 (63.3)	30 (46.9)	49	0.064
		Inconsistent supply of pens	8 (26.7)	32 (50.0)	40	
		Other	3 (10.0)	2 (3.1)	5	
Duration of insulin pen use		<1year	20 (58.8)	13 (21.7)	33	**<0.001**
		≥1year	14 (41.2)	47 (78.3)	61	
Source of knowledge on insulin pens	For those who use the insulin pen	Doctor/physician/ healthcare worker	25 (73.5)	5 (8.3)	30	**<0.001**
		Organised training at the clinic	1 (2.9)	52 (86.7)	53	
		Friend/clinic mate	1 (2.9)	3 (5.0)	4	
		Social media	-	-	0	
		Chemist/pharmacy	5 (14.7)	-	5	
		Other	2 (5.9)	-	2	
	For those who do not use the insulin pen	Doctor/physician/ healthcare worker	10 (33.3)	1 (1.6)	11	**<0.001**
		Organised training at the clinic	8 (26.7)	56 (87.5)	64	
		Friend/clinic mate	5 (16.7)	6 (9.3)	11	
		Social media	4 (13.3)	1 (1.6)	5	
		Chemist/pharmacy	1 (3.3)	-	1	
		Other	2 (6.7)	-	2	

Attitude towards insulin pens among diabetic patients in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital

All 94 participants who use insulin pens unanimously agreed that they are easy to carry around and store, while a majority agreed that pens are not painful during injection (88.2% in KNH versus 86.7% in PKH). Most participants disagreed that insulin pens are affordable (76.5% in KNH versus 75.0% in PKH). The findings are presented in **Table 2**.

Table 2: Attitude towards insulin pens by diabetic patients in Kenyatta National Hospital and P.C.E.A. Kikuyu hospital

Question	Categories	KNH n(%)	PKH n(%)	Total	P-value
Insulin pens are not painful during injection	DA/SDA[1]	1 (2.9)	6 (10.0)	7	**0.261**
	NA/DA[2]	3 (8.8)	2 (3.3)	5	
	A/SA[3]	30 (88.2)	52 (86.7)	82	
Insulin pens are easy to carry around and store	A/SA	34 (100.0)	60 (100.0)	94	**1.0**
Insulin pens are affordable	DA/SDA	26 (76.5)	45 (75.0)	71	**0.981**
	NA/DA	3 (8.8)	6 (10.0)	9	
	A/SA	5 (14.7)	9 (15.0)	14	

[1] DA/SDA = Disagree or Strongly disagree

[2] NA/DA = Neither Agree nor Disagree

[3] A/SA = Agree or Strongly Agree

Practice Around Insulin Pens among Diabetic Patients in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital.

A statistically significant difference was noted in the Practice around insulin pens, with more PKH patients having good practices compared to KNH (93.3% versus 61.8%, $p<0.05$). **Figure 1** illustrates the Practice around insulin pens.

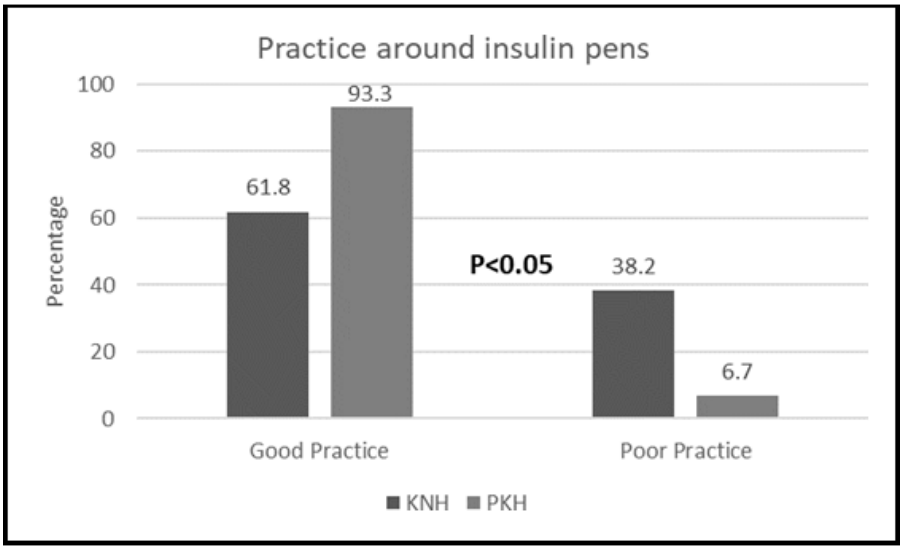

Figure 1: Prevalence of good practices with regard to insulin pens in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital

Further, it was noted that only two-thirds of patients in KNH primed their pens compared to nearly all in PKH (62% versus 97%, p<0.001). Overall, most knew how to select their dose of insulin (n=88), and only five patients did not know. The most worrying finding was that about three-quarters did not remove insulin needles frequently (PKH 72% versus KNH 77%). **Table 3** summarises these findings.

Table 3: Use of insulin pens by diabetic patients in Kenyatta National Hospital and P.C.E.A. Kikuyu hospital

Variable	**Categories in the variable**	**KNH n(%)**	**PKH n(%)**	**Total**	**P-value**
Knows how to select the right dose of insulin with the insulin pen.	No	2 (5.9)	3 (5.0)	5	0.741
	Yes	32 (94.1)	56 (93.3)	88	
	Not sure/ I do not know.	-	1 (1.7)	1	
Prime the pen before use.	No	4 (11.8)	1 (1.7)	5	**<0.001**
	Yes	21 (61.8)	58 (96.6)	79	
	Not sure/ I do not know	9 (26.4)	1 (1.7)	10	
Frequency of removing the insulin needle from the pen after use	After single use	-	7 (11.7)	7	0.102

	After five uses	8 (23.5)	10 (16.7)	18	
	After more than five uses	26 (76.5)	43 (71.6)	69	

Physicians' Knowledge, Attitude and Practice towards Insulin Pens

Physicians' Knowledge of Insulin Pens

All physicians had good knowledge of insulin pens in both KNH and PKH (83.3% versus 100%). They all knew about insulin syringes and vials as well as insulin pens, while only half reported knowing about the artificial pancreas (50%). Up to 64% knew that insulin pens can contain more than one type of insulin, and 79% knew that they can be stored at room temperature during use, as shown in **Table 4.** Unanimously, all 14 physicians recognised that insulin pens are not insured by the National Hospital Insurance Fund (NHIF).

Table 4: Physician knowledge on insulin pens in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital

Question	Categories	KNH n (%)	PKH n (%)	Total
Which insulin delivery devices do you know?	Insulin syringe and vials	12 (100.0)	2 (100.0)	14
	Insulin pens	12 (100.0)	2 (100.0)	14
	Insulin pumps	11 (91.7)	2 (100.0)	13
	Artificial pancreas	6 (50.0)	1 (50.0)	7
Each insulin pen only contains One type of insulin.	Yes	3 (25.0)	2 (100.0)	5
	No	9 (75.0)	-	9
Insulin pens can be stored at room temperature once opened and in use.	Yes	9 (75.0)	2 (100.0)	11
	No	3 (25.0)	-	3
Insulin pens are covered by the NHIF	Yes	-	-	-
	No	12(100.00)	2 (100.00)	14

Physicians' Attitude towards Insulin Pens

All physicians agreed that insulin pens give accurate doses of insulin and that they are easy to carry around and store. Most of them felt that the cost of pens was not sustainable among patients (n=8) and that these

pens were less painful during injection compared to the insulin syringe and needle (n=9). Moreover, eleven physicians believed that insulin pens are not complicated/ difficult to use.

Physicians' Practice around Insulin Pens

When compared to KNH, all the physicians in PKH knew how to use insulin pens (PKH 2 versus KNH 10), had placebo pens for demonstration (PKH 2 versus KNH 6) and rolled pens before use (PKH 2 versus KNH 6). Most physicians were prescribing insulin pens (n=9), but they were not sure how frequently they did. (See **Table 5**).

Table 5: Physician practice around insulin pens in Kenyatta National Hospital and P.C.E.A. Kikuyu Hospital

Question	Categories	KNH n (%)	PKH n (%)	Total
Q1: Do you know how to use an insulin pen?	Yes	10 (83.33)	2 (100.00)	12
	No	2 (16.67	-	2
Q2: Do you have a 'placebo' insulin pen for demonstration to your patients, based on the facility where One works.	Yes	6 (50.00)	2 (100.00)	8
	No	6 (50.00)	-	6
Q3: How frequently do you prescribe insulin pens?	At least once every clinic day	2 (16.67)	-	2
	≥2 times every clinic day	1 8.33)	-	1
	I prescribe, but I am not sure how often	7 (58.33)	2 (100.00)	9
	I do not prescribe insulin pens	2 (16.67)	-	2
Q4: Insulin pens should be rolled/rubbed before use	Yes	6 (50.00)	2 (100.00)	8
	No	6 (50.00)	Nil	6

Discussion

Knowledge of insulin pens was considered adequate, with up to 188 (62.7%) participants reporting knowing about insulin pens. A study conducted indicated that 71.4 per cent of participants knew about different insulin delivery devices, but it did not go further to probe into the percentages for the specific insulin delivery devices, including insulin pens, insulin pumps, artificial pancreas, among others.

Organised training at diabetic clinics, such as PKH, may be more impactful than one-on-one sessions with physicians, as in KNH, in informing patients about insulin pens. There was a scarcity of data exploring the sources from which patients acquire their knowledge about insulin pens.

A study carried out in East Africa corroborated our results, concluding that insulin pens are costly; it further highlighted that this is a common trend, particularly in Low- and Middle-Income Countries (LMICs). Contrary to this, some studies reported that in the long run, insulin pens are cost-effective for diabetics since they have been associated with better adherence and health outcomes.

The use of insulin pens was increasingly being embraced in KNH and had already been embraced in PKH, as more PKH patients had used insulin pens for more than a year compared to KNH (78.3% versus 58.8%). Notably, few studies have explored the adoption of insulin pens, and this could be an area for future research.

The attitude toward insulin pens was favourable, with our study aligning with other studies on the view that pens are considered less painful and are easy to carry around and store. Both our study and others have reported on the affordability of insulin pens. Some studies indicate that pens are not affordable. However, another study argued that with long-term use, insulin pens can be considered affordable.

Our study reported overall good Practice regarding the use of insulin pens, highlighting the priming of insulin pens, contrary to another study that reported poor Practice on insulin pen priming. The factors behind these observations were not listed and may need further investigation. Further, we 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, even when using insulin pens. This was observed in other studies as well.

There were limited studies that focused on physicians regarding KAP on insulin pens. Our study reported that most physicians had practised for less than two years in the diabetes clinics but had good knowledge. However, there were knowledge gaps around insulin delivery devices like the artificial pancreas and the types of insulin in insulin pens. Most physicians agreed that insulin pens can be stored at room temperature during use. Storage of in-use insulin pens at room temperature has been supported by treatment guidelines.

All the physicians who participated in the study agreed that insulin pens are not covered by NHIF. This was contrary to our findings, which indicated that insulin was listed as an essential medicine that would be supplied to a patient as part of the NHIF benefit package and that it would be "provided as per the needed care and based on the accreditation status of the health facility". As such, insulin, regardless of the insulin delivery device, would be included in the NHIF benefit package and would be provided to patients. Our study indicates that most physicians feel that insulin pens are expensive for patients, less painful on

injection, easy to use, carry and store, and they give accurate doses of insulin. Several other studies have quoted that the cost of insulin pens can be prohibitive and potentially limit their accessibility to a wide range of individuals, while supporting the other benefits listed by our study.

Good Practice was reported in knowing how to use insulin pens, including rolling them before use and having a placebo pen for demonstrations. However, a gap in prescription patterns was noted because most physicians reported prescribing them but not keeping track of how often. This gap could form the basis for future studies.

Study Limitations

The small physician sample size may not truly reflect the findings on knowledge, attitude and Practice around insulin pens; therefore, future studies can focus on getting a reasonable sample size for physicians.

5.0 CONCLUSION AND RECOMMENDATIONS

Conclusion: Adequate knowledge, a favourable attitude, and good Practice toward insulin pens were reported among both diabetics and physicians in the two facilities. Good KAP is essential for promoting the adoption of insulin pens, optimising their benefits, and ultimately leading to improved clinical outcomes. This study's assessment of KAP highlighted gaps and areas for future research.

Recommendations: 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. Retraining should be considered for some aspects of insulin handling where participants were significantly misinformed, for example, insulin storage during use and frequency of insulin needle change. Continuous retraining of physicians should be considered to familiarise them with current trends in insulin use, notably, few physicians knew about the latest advancements in insulin delivery systems, that is, the artificial pancreas and the role of NHIF in insulin therapy coverage.

6.0 REFERENCES

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