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Original Research Article

Clinical Characteristics, Predictors of Complications and Therapeutic Options of Diabetes Mellitus among Diabetic Patients Attending a Lone Tertiary Health Facility in The Gambia

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Background

Recent studies emanating from sub-Sahara Africa suggest increasing burden of Diabetes Mellitus (DM). This is not surprising, given the unprecedented economic growth rate in sub-Sahara Africa (SSA), as it has implications on the emergence of chronic diseases. These economic gains, may however, be threatened by the debilitating impacts of chronic diseases. Sadly, limited data on the clinical characteristics and therapeutic options are available in health care settings in SSA, as these impact (negatively) on the outcome of diabetes patients' care and management.

Method

A cross-sectional study was conducted involving 243 adult diabetic patients attending the medical out-patient unit in the lone tertiary health centre in The Gambia. We analysed clinical characteristics, socio-demographic variables, predictors of complications and therapeutic options among DM patients using relevant statistical techniques.

Results:

The result of the study showed the preponderance of certain characteristics among diabetics such as Type 2 DM (93.8%), positive family history (77.8%), female (63.8%), middle age -30 and 60 years (76.1%) and poverty (67%). While 60.1% of participants had at least one complication, the common complications are lower extremity disorders (54.8%) visual disorders (46.3%), heart failure (3.2% and renal failure (2.5%). Furthermore, the predictors of having complications were being female (aOR= 5.1; p=0.0172), co-exiting hypertension (aOR=10.78; p=0.0029), duration (1-5years) of DM (aOR=2.3; p=0.0125), poor treatment compliance (aOR=3.8; p=0.0094) and physical inactivity (aOR=6.78; p=0.0039). Limited therapeutic options are available in our study setting - 45% of participants were on Glibencliamide and Metformin while 38.7% of participants were on Insulin therapy. Also the median duration of switch from Oral Hypoglycemic Agents to Insulin was 18months among this study population. 84.2% of participants had at least one episode of interrupted supply of medication within the last 6months.

Conclusion

The study has provided opportunities for policy makers and researchers to combat the damaging impacts of DM on public health and the economy as insights into the clinical characteristics, socio-demographics, predictors of complications and therapeutic challenges identified, can be used, as suggested in the paper, to map out interventions capable of mitigating the impacts of DM burden in The Gambia, and SSA at large.

Strength of the paper

1. **The only study that has investigated the clinical characteristics, socio-demographics, predictor of complications and therapeutic options among diabetics in The Gambia.**
2. **We abstracted clinical data such as Type of DM, symptoms at presentation, complications, co-morbidities and medications from the participants' records- this galvanised/augmented the data from direct interviews via questionnaire administration.**
3. **Findings from our study suggest that the earlier prediction of a shift in epidemic of DM from the elderly to the younger age group may not be far-fetched as 76% of the patients were between 30 and 60 years**
4. **Essentially, our study findings were consistent with previous reports-preponderance of type 2, delayed or late diagnosis, 72% of patients first presented to a traditional healer with symptoms suggestive of DM while positive family history and obesity were found to be independent risk factors. However, we found few contrary results as DM is commoner among people of lower socio-economic status (67%) while there was also a significant gender difference- female being more likely to have DM (63.8% vs 36.2%; p<0.001)**
5. **There is limited drug options (OHA), high rate of non-compliance to oral hypoglyacemic agent (93.4%), frequent interruption of insulin supply – all these contribute to poor management outcome.**
6. **As seen in other spheres (51), e-Health strategies such as the use of short messages systems (SMS) by health professionals to remind patients to take their medicines can also be a useful strategy to improve compliance in our setting.**

Limitations of the study

1. **Though, pockets of diabetics do patronise other health care providers (orthodox and non-orthodox) and may not have been represented, however, the study participants were recruited from the lone tertiary health facility (only referral centre) in The Gambia, where majority of the general population seek specialist treatments.**
2. **The majority of our study participants have little or no western education, therefore understanding of the questionnaires (written in English) were heavily dependent on the interpretations given by the interviewers, and consequently, responses from participants may be prone to both misrepresentation (of respondents) and translation bias. However, this drawback is limited or minimised owing to the fact that the interviewers were trained indigenous nurses.**

Keywords: Diabetes Mellitus, The Gambia, Chronic disease, Oral Hypoglycemic Agents, Insulin, Complications, Clinical Characteristics, Predictors, e-Health and Public Health

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CLINICAL CHARACTERISTICS AND THERAPEUTIC OPTIONS OF DM IN THE GAMBIA

Background

In recent years, there has been growing evidence about the remarkable economic growth that Sub-Saharan Africa (SSA) has experienced. In 2013, the average economic growth rate in the region was estimated at 5%, a figure that far outpaced the global average [1]. This unprecedented economic growth has driven down the number of Africans living on less than $1.25 a day by approximately 10% within two decades [2]. At the same time, this progressive-and- sustained-economic growth has resulted in rapid urbanisation, with over a third of Africa's 1 billion people residing in urban areas [3]. These socio-demographic changes, alongside positive economic growth, have led to profound lifestyle changes across several SSA societies, including physical inactivity, increased consumption of unhealthy diet, and harmful use of alcohol and tobacco amongst others [4, 5]. The increasing prevalence of these risk factors has, in turn, resulted into alarming rates of chronic non-communicable diseases (NCDs) such as Diabetes Mellitus (DM) in SSA [6].

According to the International Diabetic Federation (IDF), an estimated 19.8 million adults in SSA were living with DM in 2013, a figure that is expected to rise to 41.5 million by 2035 [7]. These current estimates may even be an underestimation of the true prevalence of the disease as over 50% of the people with DM in the region are undiagnosed [8-12]. This growing prevalence of DM is already exerting enormous public health and economic burden on the region. For instance, in 2013 over half a million people in the region, 76% of whom were of working age (20-60 years), lost their lives to DM [7]. One consequence of this reduction in workforce is the loss of productivity, which in turn, has a negative impact on household budgets and national economies. Indeed, according to Kirigia et al, (2009), SSA incurred a total economic loss of US$ 67.03 billion from DM in 2000 [13].

Kirigia's estimate, however, did not factor in the cost of diabetic complications, which undoubtedly, are the major drivers of diabetes related cost [14]. As these complications generally require prolonged hospital admissions, they can account for up to 56% of the total direct cost of treating DM [15]. Aside medical cost, complications of DM can considerably affect economic productivity through job absenteeism. Furthermore, apart from its high mortality, crippling (physical) disabilities and dire economic consequences, DM greatly increases the risk of other NCDs such as stroke, heart attack and hypertension [16] as well as some deadly communicable diseases such as tuberculosis (TB) [17], and malaria [18]. Therefore, concerted and aggressive efforts to address DM will result into significant societal gains, including positive public health and economic outcomes.

Despite the clear societal benefits of addressing the scourge of DM, the condition continues to receive little attention from health policy makers in SSA. In view of its low priority ranking on the health agenda, many health care systems in the region are yet to undergo the structural and infrastructural evolution that is needed to address its rising prevalence. Even the health care systems that have had some form of health reforms, significant gaps still exist, including irregular supply of critical anti-diabetic medications, asymmetrical distribution of health facilities, shortage of staff, inadequate record keeping, absence of any form of medical insurance and limited state-funding for diabetic care amongst others [8, 19, 20]. These gaps further contribute to the precarious situation of DM in SSA.

Apart from the above limitations of health care systems, research on DM has also received little attention in SSA. As such, there is scarcity of data across the region [6, 21, 22], which can inform policy and enable the establishment of public health priorities as well as the development of rationale for disease prevention and control strategies. The dearth of data on diabetes in the region is clearly evident from three widely cited reviews [21-23]. In these studies, the authors conducted a systematic review of all papers published on DM in the region and from the reviews, it can be deduced that the median research output on DM is about 2.5 papers per country (range 1-4), with the largest number of papers coming from Cameroon, Kenya, Nigeria and South Africa. No published paper on DM was identified for several countries including, The Gambia. Consequently, this paper aims at investigating the clinical characteristics and pharmacotherapeutic issues among DM patients attending the lone tertiary health facility in The Gambia.

METHODS

Study setting

The study was undertaken in The Gambia. The Gambia is the smallest country in mainland Africa, with a total area of 11,300 square kilometres. It is located in the western coast of Africa, where it is completely surrounded by Senegal except for a small coastline on the Atlantic Ocean in the west. It has a population of about 1.7 million inhabitants and the population is growing at a rate of 2.3%[24]. The population is mainly youthful with about 53.4% falling in 15-64 years age brackets. In recent years, the country has witnessed a rapid increase in urbanisation. Indeed, the rate has increased from 30.8% in 1983 to 50.3% in 2003, implying that over half of the population currently live in urban areas [25].

The country has limited natural resources; consequently, agriculture remains the main stay of the economy. Commerce, mainly agro applied products as well as remittances (money sent home from family members who are living abroad) are important for micro or local economy (household sustenance). The limited natural resource base has led the government to develop liberal trade policies, which have encouraged the development of tourism, banking, and telecommunication sectors amongst others. The liberal trade policies has resulted in a sound economic growth of more than 4% in recent years [4]; however, the positive effect of this economic growth is

being counteracted by the high population growth rate. As a result close to 60% of Gambians live below the international poverty line [4].

Like many sub-Saharan African countries, The Gambia is experiencing a rapid epidemiological transition, characterised by an increasing prevalence of chronic non-communicable diseases. In 2012, there were an estimated 22,000 people (or 1.3% of the total population) living with DM; this figure is projected to reach 61.000 by 2030 [26]. This rising burden of DM, alongside the growing prevalence of other chronic non-communicable diseases is imposing substantial challenges to the health care system. However, the country does not have adequate public health infrastructure to address the rising burden of DM. Most diabetic patients receive medical care at the Edward Francis Small Teaching Hospital (EFSTH; formerly called Royal Victoria Teaching Hospital), which is the only tertiary health institution in the country. This health institution is located in the capital city, Banjul, and has a capacity of 540 beds. The institution runs several medical outpatient clinics, including the diabetic clinics which hold on Wednesdays.

Procedures

Our study population was randomly drawn from a pool of patients attending weekly diabetic clinics at the medical outpatient department (MOPD) of EFSTH, Banjul. We collected data from 243 participants from October-December 2012. Briefly, the study was explained to all patients attending the facility during the study period by one researcher and two trained nurses working at the MOPD. Participants who agreed to take part in the study were requested to provide consent by signing or thumb printing on a consent form. Thereafter, participants' medical records-including patient cards were consulted and relevant information abstracted on to a two-page questionnaire that was developed and pretested for the study.

We abstracted clinical data such as Type of DM, symptoms at presentation, complications, co-morbidities and medications from the participants' records. Our questionnaire also had provisions for data that can be obtained by direct questioning of participants. Such data, which are rarely documented on patients' records, included socio-demographic characteristics and certain patients' attitudes such as first point of care where medical attention was sought. In instances where certain information was not available on the patient's notes, we obtained this information by direct questioning of the participants.

Statistical analysis

All questionnaires were reviewed for completeness and accuracy before data entry. Data was double entered in EPI info version 7.0 (CDC Atlanta) and exported to Stata, version 12.1 (StataCorp LP, College Station, Texas, USA) for analysis. We used summary statistics to calculate point estimates for all background characteristics and other variables measured in the study. Data were reported as proportions (%) for categorical variables and means $\pm$ Standard deviation for continuous variables. In addition, we assessed the effect of various independent variables (such as age, sex, ethnicity, adherence to treatment and co-morbidities) on the probability of having any complication of DM. To this end, we used logistic regression models to estimate Odds ratios (OR) and their 95% Confidence Interval (CI) while mutually adjusting for the confounding effects of other factors under investigation. In all regression models, the outcome of interest was the presence of any complication of DM. All tests were conducted at an alpha level of 5% and hence, any p-value of less than 0.05 was considered as a significant association. Results are presented in text, tables and graphs.

Ethical aspects

The study was reviewed and approved by the Ethical and Research Committee of EFSTH. Informed consent was obtained from all participants and data collected were kept confidential. No names were mentioned in the questionnaire.

RESULTS

Baseline characteristics of study population

Overall, consent was obtained from a total of 243 participants. Table 1 presents the baseline characteristics of these participants. The mean age of the study population was 50.7 $\pm$ 12.5 years (range18-80 years) and over 75% of these participants were aged between 30 and 60 years. Over 60% of our study population was females. The predominant ethnic groups were Mandinka (33.7%) followed by Wolof (24.3%) and then Fula (21.8%). Over half (55%) of these participants had no formal education and 67% of them were unemployed.

Over half (53.1%) of our study population has been living with DM for a period of one to five years and over three-quarters (77.8%) had a family history of DM. Approximately 9 in 10 of them (87.6%) had a sedentary lifestyle marked by physical inactivity (absence of any form of physical exercise). A low prevalence of smoking (1.2%) and alcoholism (2.1%) were noted. Furthermore, over half (52.3%) of the study participants had essential hypertension and a relatively small proportion of them had Asthma (1.2%), Tuberculosis (0.8%), Peptic Ulcer Disease (5.3%), Epilepsy (0.4%), Gout (1.6%), and Arthritis (6.5%).

Clinical characteristics of study population

The clinical characteristics of our study population are presented in Table 2. As can be seen, Type 2 DM accounted for 93.8 % of all cases of DM while Type 1 DM was present in 14 (5.8%) participants. Furthermore, gestational diabetes was detected in one participant (0.4%). No other forms of DM were identified in our study population.

A survey of the cases distributed by year of diagnosis is given in Figure 1. As illustrated, close to 80% of our study population was diagnosed with DM within the last 10 years.

Table 1: Baseline characteristics of study population

Variable	n (%)	95% Confidence Interval
Age (in years)		
< 30	9 (3.7)	1.71-6.91
30-60	185 (76.1)	70.27-81.35
>60	49 (20.2)	15.31- 25.77
Sex		
Females	155 (63.8)	57.40-69.83
Males	88 (36.2)	30.17-42.60
Ethnicity		
Mandinka	82 (33.7)	27.1-40.7
Wolof	59 (24.3)	18.9-30.8
Fula	53 (21.8)	16.1-27.9
Others	49 (20.2)	14.9-26.0
Education		
None	45 (18.5)	13.5-24.5
Arabic School	89 (36.6)	29.4-43.2
Primary school	26 (10.7)	6.6-15.7
Secondary school	37 (15.2)	10.4-20.7
High school	35 (14.4)	9.9-20.2
University	11 (4.5)	1.2-8.7
Marital Status		
Married	183 (75.3)	68.9-81.4
Single	17 (7.0)	3.9-11.5
Separated	7 (2.9)	1.2-6.4
Divorced	15 (6.2)	3.5-10.7
Widowed	21 (8.6)	4.4-12.8
Employment status		
Unemployed	95 (66.9)	60.5-71.8
Civil servants	44 (18.2)	13.7-24.4
Farming	20 (8.3)	5.2-12.3
Petit trading	65 (26.9)	21.3-32.5
Others	18 (7.4)	4.6-11.6
Risk factors for DM (% yes)		
Family history	189 (77.8)	72.0-82.1
Smoking	3 (1.2)	0.2-5.3
Alcohol	5 (2.1)	0.6-7.7
Physical inactivity	213 (87.6)	82.8-91.5
Duration of DM since diagnosis		
<1 year	20 (8.2)	4.8-13.6
1-5 years	129 (53.1)	44.7-57.6
5-10 years	45 (18.5)	13.8-24.7
<10 years	49 (20.2)	17.8-28.7

Table 2: Clinical characteristics of study population

Variable	n (%)	95% Confidence Interval
Type of DM		
Type 1	14 (5.8)	2.3-9.2
Type 2	228 (93.8)	88.7-97.5
Gestational	1 (0.4)	0.01-2.3
Diagnosis		
Complication of DM present at diagnosis (% *yes)*	63 (25.9)	20.5-32.0
Duration of symptoms before diagnosis		
<3 months	15 (6.2)	3.6-10.1
≥3 months	186 (76.5)	71.1-82.2
Unknown	42 (17.3)	12.4-22.9
First point of care where medical advice was sought for symptoms		
Health Facility		
Traditional Healer	68 (28.0)	23.4-34.2
	175 (72.0)	66.2-77.2
Complications of DM (yes)		
Eye complications		
Blurring of vision	87 (35.9)	28.7-51.5
Blindness	19 (7.8)	4.8-11.8
Limb disorders		
Foot ulcers	44 (18.1)	13.5-23.7
Non traumatic limb amputation	11 (4.5)	2.1-8.2

Others (pin-and-needle sensations, numbness, etc)	84 (32.2)	23.5-46.8
Heart Failure	8 (3.2)	1.8-7.1
Kidney failure	6 (2.5)	0.7-4.8
Diabetic Ketoacidosis	5 (2.1)	0.1-8.9
Stroke	2 (0.8)	0.1-9.9
Others (Skin sepsis, sexual dysfunction etc)	26 (10.6)	6.4-15.1
Current medication (% yes)		
Insulin	94 (38.7)	32.5-45.3
Metformin and glibenclamide	111 (45.6)	36.5-55.7
Metformin alone	33 (13.6)	9.9-18.3
Tolbutamide	5 (2.1)	0.1-8.9

Table 3: Odds ratios and their 95% confidence interval for the association between some selected variables of study population and the probability of having any complication of DM

Variable (reference)	Adjusted Odds Ratio*	95% C.I.	p-value
Age of participant (<30 years)			
30-60 years	1.12	0.27-4.79	0.8614
>60 years	1.23	0.32-4.72	0.7657
Sex (Female)			
Male	5.07	2.14-9.75	0.0172
Duration of DM since diagnosis (<1 year)			
1-5 years	2.31	0.50-8.37	0.0125
5-10 years	7.68	1.30-12.53	0.0020
>10 years	16.50	5.59-32.79	0.0016
Adherence to treatment (No)			
Yes	4.84	1.68-13.34	0.0094
Education (Arabic school)			
None	0.81	0.43-1.52	0.5104
Primary school	0.93	0.35-2.43	0.8821
Secondary school	0.46	0.19-1.09	0.0784
High school	0.48	0.18-1.25	0.1340
University	1.06	0.17-6.09	0.9458
Ethnicity (Fula)			
Mandinka	0.88	0.41-1.91	0.7520
Wolof	1.06	0.43-2.64	0.9006
Others	0.57	0.03-9.81	0.6952
Co-morbidities			
Hypertension (Yes vs No)	10.78	4.68-18.79	0.0029
Risk factors			
Alcohol (Yes vs No)	1.02	0.99-1.04	0.1427
Smoking (Yes vs No)	0.97	0.45-1.76	0.5246
Physical inactivity (Yes vs No)	6.78	1.93-12.37	0.0039

**Mutually adjusted for other variables shown in the table*

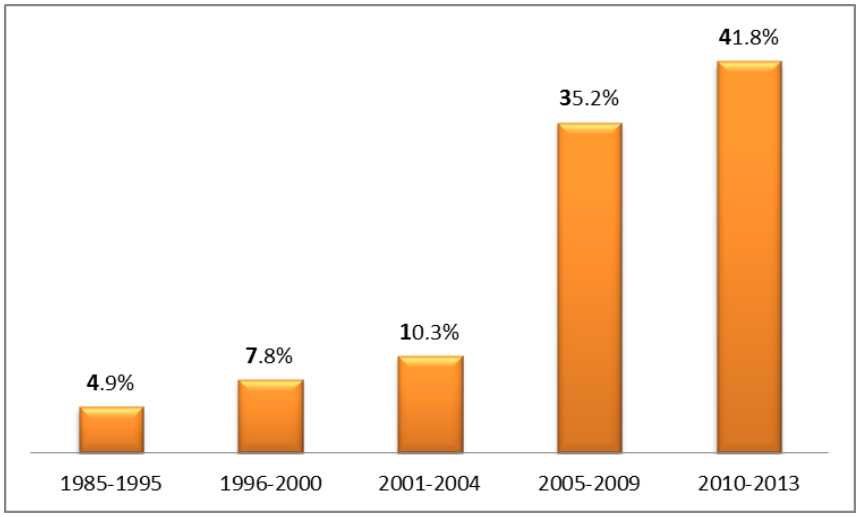

Figure 1: Proportion of Diabetics by year of diagnosis

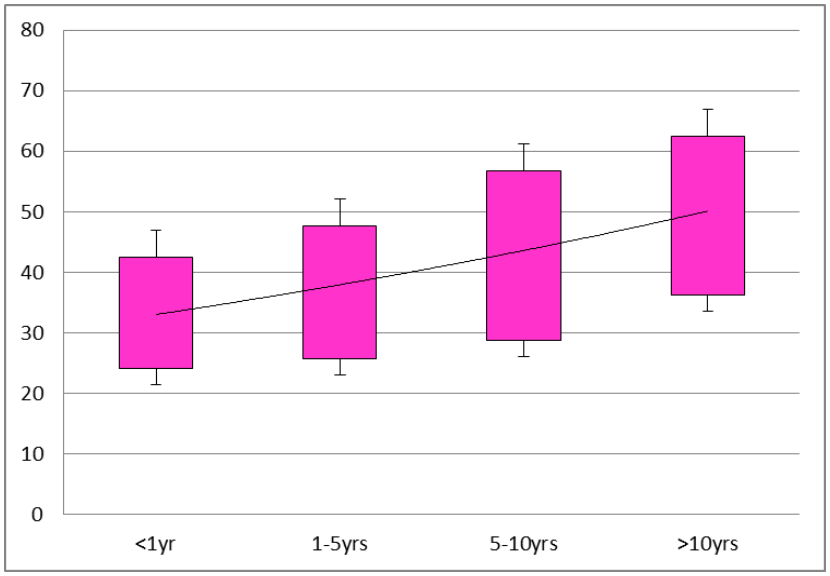

Figure 2: Daily insulin requirement in function of the duration of Diabetes

At diagnosis, all (91.7%) but 20 participants had classical symptoms of hyperglycemia and over 75% of them had these symptoms for ≥ 3 months before diagnosis (Table 2). Of the 20 participants (8.3%) who did not have any classical symptom of hyperglycemia, diagnosis of DM was established during a routine medical examination. At diagnosis, 26% of these participants had at least one complication of DM; the most frequent of which were foot ulcers (9.5%), eye disorders (8.2%) and loss of conscience (3.7%). Over 70% of these participants first sought medical attention for their symptoms from a traditional healer as opposed to a health facility (28%).

Complications of DM

Of the 243 participants, 146 (60.1%) had at least one complication of DM. As illustrated in Table 2, close to half (43.6%) of our study participants had some form of visual impairment, including blurred vision (31.3%) and irreversible vision loss (7.8%). Similarly, the prevalence of lower extremity disorders was also high (54.8%). Indeed, about a fifth (18.1%) of our participants had foot ulcerations while 11 (4.5%) have had a limb amputation. Additionally, a third (32.2%) had symptoms of peripheral neuropathy/vascular disease such as numbness and pin-and-needle sensations. Unlike eye and limb disorders, the frequency of complications such as heart (3.2%) or kidney (2.5%) failure was lower than expected.

Table 3 presents the association between some selected variables and the probability of having any complication of DM. As shown, females were more likely to suffer from a complication of DM than males (aOR= 5.1; p=0.0172). Secondly, there was a positive association between the duration of diabetes and the likelihood of developing any complication of DM. For instance, participants who have been living with DM for 1-5 years were more likely to have a complication of DM than those who have been living with the disease for less than a year (aOR=2.3; p=0.0125). Likewise, participants who did not adhere to their treatment were more likely to have a complication of DM than those who did (aOR=3.8; p=0.0094).

Additionally, participants who were physically inactive were also more likely to have a complication of DM than those who did not (aOR=6.78; p=0.0039). Finally, participants who were hypertensive were more likely to suffer from a complication of DM than those who were not (aOR=10.78; p=0.0029). Unlike the above variables, no statistically significant association was found between variable such as age, education and ethnicity and the likelihood of having a complication of DM.

Anti-diabetic medications

Our study population had access to a limited set of anti-diabetic medications (Table 2). At the time of the survey, all participants were on anti-diabetic medication with about 45% of them on combination therapy (Glibenclamide and Metformin) and a fairly similar proportion (38.7%) on insulin. Of the 94 participants who were on insulin, 51 (21%) of them were initially on oral anti-hyperglycemic agents. These participants could not achieve adequate glycemic control with oral medications and therefore required a switch to insulin. The median duration of time for this switch was 18 months (range 3-56 months). As shown on Figure 2, the daily insulin requirement increased as the duration of treatment with insulin increased. For instance, participants who have been on insulin for > 10 years required fewer units of insulin compared to those who have been on insulin for > 10 years (p< 0.0001). Availability of anti-diabetic drugs was also problematic. Indeed, 82.4% of the study population reported at least one episode of

interrupted supply of anti-diabetic medications within the last 6 months.

In such instances, most participants stopped taking the medication-as there was nothing to take-while a few others sourced from a friend or a family member. In addition, adherence to treatment was low; indeed, over 9 in 10 participants (93.4%) who were on oral anti-diabetics and 55.5% who were on insulin were non-compliant to their treatments despite the fact that these medications had a good safety profile. Overall, few participants reported any side effect to oral anti-diabetics medications, the most common of which were nausea and vomiting (6.5%), diarrhoea (3.2%), and skin rash (2.7%). However, high numbers of participants reported at least one side effect to insulin administration, including injection side pain (57.4%); injection site abscess (11.7%) and hypoglycemia (7.8%).

DISCUSSION

The Gambia, like many other SSA nations, is undergoing a rapid epidemiological transition characterised by an unfinished agenda of non-communicable diseases and the emerging tides of non-communicable diseases, including DM [27]. Consistent with estimates across SSA, Type 2 DM was found to be the predominant form of DM in our study setting as it accounted for over 93% of all cases of DM while other forms, notably Type 1 and gestational diabetes, were also found to be within the expected range for the region (see Table 2) [23, 28].

As illustrated in figure 1, there has been a remarkable escalation of the number of people with confirmed DM in our study setting over the last decade. This trend is consistent with studies from other nations in SSA that reported the sudden upsurge of DM in SSA [6, 7, 16, 21]. Several factors can account for this unprecedented upsurge of DM in The Gambia, including the rapid urbanisation that has occurred over the last two decades [25], the alarming background rates of obesity [27, 29, 30] and the high rate of physical inactivity and changes in dietary habits in our study setting [27]. In addition, lack of awareness about the disease as described by Foma et al, (2013) might also be an important contributing factor [31]. Since most of these factors are directly linked to changes in lifestyle, well structured educational programmes on DM-which seem to be absent in most SSA settings [32], can play a critical role in addressing the rising tides of DM in our setting. Such programmes have been shown to be effective in reducing the incidence of modifiable risks factors for DM in the general population as well as improving clinical outcomes and quality of life among diabetics [33].

We identified a number of important risk factors for DM in our study setting. First, a positive family history of DM was noted in approximately 4 in 5 of our participants (77.8%). Such high proportion of this independent risk factor has also been reported from Sudan [34] and rural South Africa [35]. Given this high percentage, targeted screening of family members of diabetics can be a useful strategy for controlling the disease in our setting. Second, as shown in Table 1, females were more likely to suffer from DM than males (63.8% vs 36.2%; $p<0.001$). Although this observation seems contrary to global estimates-"that sex has little effect on DM"[7, 23], however, it is not an unexpected finding in our study setting as previous studies on chronic NCDs have found an association between female sex and obesity as well as gender difference in the prevalence of NCDs [30, 36].

Obesity is a major risk factor for DM as it accounts for over 90% of all cases of DM [7]. On the other hand, this apparent gender difference in DM may be due to the fact that women are more likely to seek health care than men [27, 36]. Asides gender, our results also show that the majority of people (76.1%) who suffer from DM in our setting are within the 30-60 years age brackets. This finding appears to be in line with earlier predictions that the burden of DM in several SSA settings will shift from the elderly (>65 years) to younger age-groups as the epidemic matures [6, 21, 37]. This shift in age-bracket potentially has dire consequences on national economies and households budgets. Therefore, rationale efforts geared towards preventing or addressing the burden of DM in this age bracket may yield substantial economic and public health benefits.

Last but not least, DM was previously regarded as a disease of affluence, affecting people in high socio-economic class [38]. Our results, however, contrast this view and clearly show that in our setting, DM can be considered as a disease of poverty or people of low socio-economic status. As shown in Table 1, many of our participants were poorly educated, unemployed (67%) or had irregular employments with meagre incomes (Table 1). One of the probable explanations of why people with low socio-economic status are increasingly becoming susceptible to DM may be related to certain cultural perceptions about body size. In several SSA settings, a large body size has several positive connotations- affluence, happiness, beauty, health and the absence of diseases like TB and HIV/AIDS[36, 38]. Owing to this view, many women, particularly middle aged women, engage in unregulated use of steroids as they believe that this give them a symbol to wear with "panache and elegance" [27]. This practice has negative health implications such as the emergence of DM, and such views can only be addressed through education.

From a public health perspective, addressing the burden of DM may significantly reduce the risk of major diseases, such as TB and hypertension, to which DM is an established risk factor (17). In our study, about 1 in 2 participants had essential hypertension, a finding which is consistent with observations from other SSA settings [16]. The increasing prevalence- and the high rate of co-existence of these two conditions may greatly increase the risk of several cardiovascular conditions such as retinopathies, stroke, nephropathy and heart failure among others in our study setting. Although, we noted a comparatively low frequency of some of these chronic conditions among our study population, the low occurrence can largely be explained by grossly inadequate diagnostic facilities in our study setting, which limits routine screening for these conditions. Aside essential hypertension, we found a low proportion of diabetics with TB (0.8%) compared to other settings in SSA [17]. Although this low proportion may be due

to the low prevalence rate of TB in the general population [39], consequently, continuous monitoring is essential since there is clear evidence that DM amplifies the risk of developing TB in TB-endemic countries [17].

Late or delayed diagnosis of DM is a serious challenge across several SSA settings. In our study, as much as 3 in 4 participants were only seen at a health facility after three months of classical systems of hyperglycaemia. This relatively late presentation is generally problematic in the sense that, at the time of diagnosis, a significant proportion of patients are already in an advanced pathological stage, with one or more complications of the disease. For instance, in our study over a quarter of our participants had at least one complication of DM at the time of diagnosis. The reasons for delayed diagnosis in SSA are well known, and these include low awareness on DM, poor healthcare seeking behaviour, constrained household budgets and asymmetrical distribution of health care system with weak structural and infrastructural capacities and capabilities[21, 23, 36, 40, 41].

Another potential contributor to delayed diagnosis is the widespread belief and trust in folklore medicine among the general population. In our study, for instance, 72.0% of our participants first presented to a traditional healer with their symptoms as opposed to a health facility. Visits to a health facility only resulted after repeated visits to these healers with no positive outcomes. This is not an unusual finding in our setting where it is known that a large percentage of people seek care from traditional healers [42]. The observation is also in line with findings from other SSA nations including Kenya, Mali, Mozambique, Nigeria, South Africa and Zambia [8]. In most of these settings, traditional healers usually claim that DM is curable. Worse still, they are generally unwilling to refer patients to health facilities for proper diagnosis and management even in the presence of serious diabetic complications [43]. Owing to the fact that these beliefs and practices are deeply rooted in many African cultures, social science research on these issues may provide useful information that can enable the design of culturally appropriate interventions against these beliefs and practices. In addition to social science research, various gaps in health care systems would need to be addressed [36, 43]. This is necessary to ensure prompt diagnosis and management of the disease so as to avoid costly complications.

Diabetic complications are widely prevalent in our study setting. We noted a diagnosis of vision loss in 8% of our participants while an additional 36% have been suffering from blurred vision. Although none of these individuals with blurred vision has had an ophthalmologic eye examination, the symptom is a warning sign of an impending diabetic retinopathy that may ultimately result to severe visual impairment, if prompt detection and treatment is delayed or if hyperglycaemia level continues to be poorly controlled. It is worth noting, however, that lack of ophthalmic examination is not only problem in our setting or SSA in general, as there are indications that even in developed countries, where standard guidelines on diabetic eye care and diabetic facilities exist, up to 50% of diabetics have never had any ophthalmic eye examination [44, 45]. This high proportion is a call for concern as there are already projections that with the escalating prevalence of DM, diabetic retinopathy will become the leading cause of visual impairment globally. Therefore, there is the need to implement retinal screening and preventive treatment programmes for people with diabetes in our setting as well as other SSA. Such programme should increase awareness among health care professionals of the necessity for regular and thorough ophthalmic eye examinations for those at risk of diabetic eye disease. Ultimately, the programme should be designed to support prompt detection and treatment of diabetic retinopathy.

In addition to ocular complications, we noted a high frequency of lower extremity complications among our study participants. Indeed, 32% of our participants had clinical symptoms (numbness, paraesthesia, burning sensation etc) suggestive of distal diabetic neuropathy. This observation is consistent with a generally acceptable finding that distal neuropathy affects approximately 30% of all diabetics at anytime [46]. This complication, alongside peripheral vascular disease (which all result from inadequate glycaemic control) is a strong predictor for foot ulcerations [22]. In our study, foot ulcers were found in approximately 1 in 5 participants (18.1%), a prevalence which falls within the regional range reported by Abbas and Archibald (2007) [47].

Foot ulcerations are among the most costly complications of DM to manage. In addition, foot ulcerations are generally associated with undesirable outcomes such as progressive limb infection that can ultimately lead to amputation or death in patients who do not undergo surgery [48]. In our study, nearly 5% of participants had had a foot amputation (Table 2). This figure may even be an underestimate as there an anecdotal report by Webb et al (2006) that amputation of diabetic feet is most frequent surgical procedures in our setting [27]. Given the gravity of this complication, clear measures need to be put in place. These measures should include amongst others, tight glycemic control in diabetics, patient education on proper foot care (including regular foot inspection and avoidance of walking barefoot) and early detection of peripheral neuropathy and peripheral vascular disease in diabetics [47]

Unlike foot and eye complications, we noted a low frequency of cardiovascular disorders of DM among our study participants. As shown in Table 2, 3% of our participants were suffering from heart failure while 2.5% had chronic kidney disease. These findings are lower compared to observations from other countries in the region [16, 22, 28]. One probable explanation for this low frequency is the lack of diagnostic facilities in our setting, which is also a common problem across SSA. For instance, during data collection of our study, procedures such as coronary angiography or myocardial scintography were not available in our setting. Other simple procedures such as those aimed at detecting microalbuminuria in diabetics are not routinely performed, partly due to limited staff capacity or perennial shortages of diagnostic kits. These diagnostic challenges, which were beyond our control, imply that our findings may grossly underestimate the actual prevalence of cardiovascular complications in our setting. As

there is little doubt that the prevalence of these complications are rising in keeping with the rising tides of DM, more carefully designed studies are needed to unveil the true prevalence of these complications in our setting.

As shown in Table 3, we used logistic regression models to assess the effect of various independent variables on the likelihood of having any complication of DM in our study setting. Consistent with findings from other studies [22], duration of diabetes was a major determinant of DM related complication in our setting. In other words, the odds of developing any complication increased as the duration of DM increased. Second, sex also appeared to be an important risk factor for DM related complications in our study setting. Females were more likely to suffer from DM related complications than men. This may be due to the fact that in our setting women are more likely to be obese, sedentary and less compliance to their treatment than men. Other important predictors of complications in our setting included measures such as adherence to treatment and physical inactivity, which are all known to have an impact on adequate glycemic control.

We found that participants who were non-compliant to their treatment had an increased risk of developing complications to DM than those who were not. The same was true for participants who were physically inactive. Another important predictor of complication was the presence of hypertension; diabetics who were hypertensive were more likely to suffer from a DM related complications than those who were not. Again, most of these predictors are well known and have been extensively documented [6, 16, 21, 22, 49].

Although substantial evidence exists that weight loss, dietary modification and physical activity can prevent or delay onset of DM and its related complications [23], adherence to these simple and inexpensive non-pharmacological methods is low across SSA. Because of this low uptake, many diabetics require pharmacotherapy with anti-diabetic medication in order to achieve a suitable glycemic level. Pharmacotherapy, however, is not without challenges in SSA. For instance, in our study although all participants were on anti-diabetic medications, there were serious issues with regards to adherence to treatment regimens as well as constant availability of anti-diabetic medications. Such challenges, which are well known in many SSA settings, are major contributors to poorly controlled glycaemia. Generally, diabetics who are unable to achieve a satisfactory glycemic level with oral medication will require insulin. Given the high rate of non-compliance to oral anti-diabetics (93.4%) and frequent supply interruptions, it was not surprising to see that a large proportion of our study participants required a switch to insulin within a median time of 18 months (range 3-56 months). This shift alongside the observation that daily insulin requirement increases with the duration of therapy (Figure 2) is likely going to increase the overall demand of insulin in our setting. The observation is worrying in the sense that the demand for insulin may outstrip supply in the coming years, if measures are not taken to improve on its supply, which as of now is still erratic even across many developing countries (50). Purposeful moves to ensure constant supply as well as constant monitoring of stock levels of anti-diabetic medications in our setting are clearly needed. In addition, measures to improve compliance to treatment regimens are also needed. Again, continuous patient education can play a critical role in improving compliance. Additionally, as seen in other spheres (51), e-Health strategies such as the use of short messages systems (SMS) by health professionals to remind patients to take their medicines can also be a useful strategy to improve compliance in our setting.

We also noted a comparatively higher incidence of local side effects of insulin, most of which were related to injection site abnormalities, notably injection site pain and abscess. This finding may likely be due to poor administration techniques, which again, can be addressed through adequate patient education. Another noteworthy finding in our study was that our study population had access only to a limited set of traditional anti-diabetic medications, notably Glibenclamide, Metformin and Insulin. This limited access is occurring at a time of impressive technological advances in therapeutic approaches to DM.

Although newer anti-hyperglycaemic agents with superior properties to traditional agents, including a positive effect on cardiovascular risk factors exist in most industrialized countries [52], access to these novel therapies in developing countries seems to be hindered by the fact that these countries do not seem to offer a vibrant pharmaceutical markets for these new products [53]. Since unavailability of novel products with proven efficacy to patients who need them raises a fundamental ethical and human concern, mechanisms that can alleviate the plight of these patients are urgently needed. Mechanism such as the US President's Plan for AIDS Relief [54] is a suitable example to emulate, however, this will demand data-driven gaps to advocate for such intervention.

LIMITATIONS OF THE STUDY

Though, pockets of diabetics do patronise other health care providers (orthodox and non-orthodox) and may not have been represented, however, the study participants were recruited from the lone tertiary health facility (only referral centre) in The Gambia, where majority of the general population seek specialist treatments.

The majority of our study participants have little or no western education, therefore understanding of the questionnaires (written in English) were heavily dependent on the interpretations given by the interviewers, and consequently, responses from participants may be prone to both misrepresentation (of respondents) and translation bias. However, this drawback is limited or minimised owing to the fact that the interviewers were trained nurses.

In assessing the predictors of complications of DM, this study did not explore the influence of obesity on the presence of DM complications. This is a limitation, given the established relationships between glycaemic control, onset of complications and body weights.

CONCLUSION

This study has provided policy makers, health care providers and researchers the opportunities to combat the damaging impacts of DM on public health and the economy as insights into the clinical characteristics, socio-demographics, predictors of complications and therapeutic challenges identified, can be used, as suggested in the paper, to map out interventions capable of mitigating the severe impacts of DM burden in The Gambia and SSA at large.

For instance, targeted screening can be provided for individuals between 30 and 60years of age with positive family history of DM, improving health access and health seeking behaviour to prevent delay in diagnosis and onset of complication(s), the need to increase investment in diagnostic facilities and ensuring the availability and affordability of wide range of pharmaceutical products(chronic disease medications) as well as massive health education campaigns on the symptomatology, risk factors, complications, early diagnosis, care and treatment options.

COMPETING INTEREST

The authors declared no conflict of interest in the design, conduct and reporting of the study findings.

AUTHORS' CONTRIBUTION

SY participated in the design of the study, developed the study tools, participated in the data analysis and wrote the most part of the first draft of the manuscript. OSA participated in the design of the study and its coordination, wrote part of the manuscript and critically revised the first draft of the manuscript. FMA participate in the design of the study and acquisition of the data. BA participated in the design of the study and acquisition of the data. JJ led the data analysis process. All authors read and approved the final manuscript.

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REFERENCES

1. International Monetary Fund: World Economics and Financial Surveys: Sub-Saharan Africa Builds Momentum in a Multi Speed World. *Regional Economic Outlooks* 2013.
2. IMPACT: Sub-Saharan Africa Economic Growth to Outpace Global Average. 2014.
3. UN HABITAT: The State of African Cities 2010, Governance, Inequality and Urban Land Market 2013.
4. World Bank: The Gambia: An Assessment of Poverty. 2011.
5. Motala A, Omar M, Pirie F: Diabetes in Africa. Epidemiology of type 1 and type 2 diabetes in Africa. *J Cardiovasc Risk* 2003, 10(2):77 - 83.
6. Mbanya JCN, Ayesha A. Motala, Eugene Sobngwi, Felix K. Assah, and Sostanie T. Enoru. : "Diabetes in sub-Saharan Africa." *Lancet* 2010, 375(9733):2254-2266.
7. International Diabetic Federation: IDF Diabetic Atlas: Africa at a Glance. 2014.
8. Alla MAaS: Diabetes in Sub-Saharan Africa: Kenya, Mali, Mozambique, Nigeria, South Africa and Zambia. *Int J Diabetes Dev Ctries* 2008 28 (4):101-108. .
9. Ministry of Health: Cameroon Burden of Diabetes Project (Cambod): Baseline Survey Report. 2004.
10. Christensen D: Prevalence of glucose intolerance and associated risk factors in rural and urban populations of different ethnic groups in Kenya. *Diabetes Res Clin Pract* 2009, 84(3):303 - 310.
11. Nyenwe E: Type 2 diabetes in adult Nigerians: a study of its prevalence and risk factors in Port Harcourt, Nigeria. *Diabetes Res Clin Pract* 2003, 62(3):177 - 185.
12. Balde N: Diabetes and impaired fasting glucose in rural and urban populations in Futa Jallon (Guinea): prevalence and associated risk factors. *Diabetes Metab* 2007, 33(2):114 - 120.
13. Kirigia J: Economic burden of diabetes mellitus in the WHO African region. *BMC Int Health Hum Rights* 2009, 9:6.
14. Ringborg A, Cropet C, Jönsson B, Gagliardino JJ, Ramachandran A, Lindgren P: Resource use associated with type 2 diabetes in Asia, Latin America, the Middle East and Africa: results from the International Diabetes Management Practices Study (IDMPS). *International Journal of Clinical Practice* 2009, 63(7):997-1007.
15. Mbanya JC: Diabetes Cost: Sub-Saharan Africa Perspective. *International Textbook of Diabetes Mellitus* 2003.
16. Kengne AP, Amoah AGB, Mbanya J-C: Cardiovascular Complications of Diabetes Mellitus in Sub-Saharan Africa. *Circulation* 2005, 112(23):3592-3601.
17. Young F, Critchley J, Johnstone L, Unwin N: A review of co-morbidity between infectious and chronic disease in Sub Saharan Africa: TB and Diabetes Mellitus, HIV and Metabolic Syndrome, and the impact of globalization. *Globalization and Health* 2009, 5(1):9.
18. Ina Danquah GB-A, and Frank P. Mockenhaupt: Type 2 diabetes mellitus and increased risk for malaria infection. *Emerging Infectious Diseases,* 2010, 16(10):1601-1604.
19. Beran D, Yudkin J, de Courten M: Access to care for patients with insulin-requiring diabetes in developing countries: case studies of Mozambique and Zambia. *Diabetes Care* 2005, 28(9):2136 - 2140.
20. Whiting DR, Hayes L, Unwin NC: Challenges to Health Care for Diabetes in Africa. *European Journal of Cardiovascular Risk* 2003, 10(2):103-110.
21. Hall V, Thomsen R, Henriksen O, Lohse N: Diabetes in Sub Saharan Africa 1999-2011: Epidemiology and public health implications. a systematic review. *BMC Public Health* 2011, 11(1):564.
22. G TSaG: Chronic diabetic complications in Africa. *African Journal of Diabetes Medicine* 2011, 19(1).
23. Mbanya J: Diabetes in sub-Saharan Africa. *Lancet* 2010, 375(9733):2254 - 2266.
24. World Bank: World Development Indicators: The Gambia. 2014.
25. Site GI: Population Figures For Gambia. 2014.
26. Organization: WH: Diabetes Programme. Country and regional data on diabetes. . *WHO African Region 2012*.
27. Webb F, Prentice A: Obesity amidst poverty. *International Journal of Epidemiology* 2006, 35(1):24-30.
28. Abbas Z, Archibald L: Challenges for management of the diabetic foot in Africa: doing more with less. *Int Wound J* 2007, 4(4):305 - 313.
29. M Siervo PG, O A Nyan and A M Prentice: Urbanization and obesity in The Gambia: a country in the early stages of the demographic transition. *European Journal of Clinical Nutrition* 2006, 60: 455-463.
30. Marianne A. B. van der Sande SMC, Paul J. M. Milligan, Ousman A. Nyan, Winston A. S. Banya, Andrew Prentice, Keith P. W. J. McAdam and Gijs E. L. Walraven: Obesity and Undernutrition and Cardiovascular Risk Factors in Rural and Urban Gambian Communities. *Am J Public Health* 2001, 91(10):1641-1644.
31. Foma M, Saidu Y, Omoleke S, Jafali J: Awareness of diabetes mellitus among diabetic patients in the Gambia: a strong case for

health education and promotion. *BMC Public Health* 2013, 13(1):1124.
32. AS Tan LY, S Wan, ML Wong . : Patient education in the management of Diabetes Mellitus *Singapore Medical Journal* 1997, 38(4):156-160.
33. Funnell MM, Brown TL, Childs BP, Haas LB, Hosey GM, Jensen B, Maryniuk M, Peyrot M, Piette JD, Reader D *et al*: National Standards for Diabetes Self-Management Education. *Diabetes Care* 2010, 33(Supplement 1):S89-S96.
34. MN Elbagir ME, EMA Elmahadi , IMS Kadam , C Berne . A population-based study of the prevalence of diabetes and impaired glucose tolerance in adults in northern Sudan. *Diabetes Care* 1996, 19 1126-1128.
35. Motala A: Diabetes and other disorders of glycemia in a rural South African community: prevalence and associated risk factors. *Diabetes Care* 2008, 31(9):1783 - 1788.
36. Omoleke. SA: Chronic Non-comunicable Diseases as a New Epidemic in Africa: Focus on The Gambia. . *The Pan African Medical Journal* 2013, 14(87).
37. Guariguata L, Whiting D, Weil C, Unwin N: The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. *Diabetes research and clinical practice* 2011, 94(3):322-332.
38. Levitt N: Diabetes in Africa: epidemiology, management and healthcare challenges. *Heart* 2008, 94(11):1376 - 1382.
39. Bank W: Incidence of tuberculosis (per 100;000 people) in Gambia. *Trading Economics* 2013.
40. Beran D, Yudkin J: Looking beyond the issue of access to insulin: What is needed for propoer Diabetes care in resource-poor settings. *Diabetes Atlas, IDF* 2009.
41. All MAaS: Diabetes in Sub-Saharan Africa: Kenya, Mali, Mozambique, Nigeria, South Africa and Zambia. *Int J Diabetes Dev Ctries* 2008, 28(4):101-108.
42. Ministry of Health And Social Welfare TG: Gambian National Health Policy 2012-2020. 2012.
43. Levitt NS: Diabetes in Africa: epidemiology, management and healthcare challenges. *Heart* 2008, 94(11):1376-1382.
44. Fong DS, Aiello L, Gardner TW, King GL, Blankenship G, Cavallerano JD, Ferris FL, Klein R: Retinopathy in Diabetes. *Diabetes Care* 2004, 27(suppl 1):s84-s87.
45. Ross J. Brechner CCC, L. Jean Howie, William H. Herman, Julie C. Will, Maureen I. Harris: Ophthalmic examination among adults with diagnosed diabetes mellitus. *Journal of the American Medical Association* 1993, 270 , :1714-1718.
46. al. YMe: A multicentre study of the prevalence of diabetic peripheral neuropathy in the United Kingdom hospital clinic population. *Diabetalogia* 1993, 36 150-154.
47. Z Abbas LA: The diabetic foot in sub-Saharan Africa:a new management paradigm. *Diab Foot J* 2007, 10 128-136
48. Gulam-Abbas Z: Clinical outcome of diabetes patients hospitalized with foot ulcers, Dar es Salaam, Tanzania. *Diabet Med* 2002, 19(7):575 - 579.
49. G. V. Gill J-CM, K. L. Ramaiya, S. Tesfaye A sub-Saharan African perspective of diabetes *Diabetologia* 2009, 52(1):8-16.
50. Giorgino F, Leonardini A, Laviola L: Cardiovascular disease and glycemic control in type 2 diabetes: now that the dust is settling from large clinical trials. *Annals of the New York Academy of Sciences* 2013, 1281(1):36-50.
51. Trouiller P, Torreele E, Olliaro P, White N, Foster S, Wirth D, Pécoul B: Drugs for neglected diseases: a failure of the market and a public health failure? *Tropical Medicine & International Health* 2001, 6(11):945-951.
52. Saidu Y, Angelis DD, Aiolli S, Gonnelli S, Georges AM: A Review of Regulatory Mechanisms Used by the WHO, EU, and US to Facilitate Access to Quality Medicinal Products in Developing Countries With Constrained Regulatory Capacities. *Therapeutic Innovation & Regulatory Science* 2013.
53. Mendis S, Fukino K, Cameron A, Laing R, Filipe Jr A, Khatib O, Leowski J & Ewen M. The availability and affordability of selected essential medicines for chronic diseases in six selected low - and middle-income countries. Bulletin of World Health Organisation April 2007, 85(4).
54. Vervloet M, Linn AJ, van Weert, JC, de Bakker DH, Bouvy ML & van Dijk L.The effectiveness of interventions using electronic reminders to improve adherence to chronic medications: a systematic review of the literature. Journal of the American Medical Informatics Association. 2012, 19:696-704.