

Utilisation and expenditure on long-acting insulin analogues among selected middle-income countries with high patient co-payment levels: findings and implications for the future

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Abstract

The number of patients with diabetes and associated complications is rising across countries including patients requiring insulin to control their diabetes. Hypoglycaemia combined generally with poor control adds to the burden of diabetes. Long-acting insulin analogues were developed to reduce hypoglycaemia, including nocturnal hypoglycaemia, and enhance adherence, which can be a problem. These benefits have resulted in increased use among high and high-middle income countries, which is continuing. However, concerns in middle and lower-income countries as insulin analogues are considerably more expensive than standard insulins. Biosimilars can reduce their costs. Consequently, important to ascertain current usage and prices of analogues across middle-income countries with high patient co-payment levels to provide future direction. Overall, limited use of insulin glargine in Kenya up to 3.6% of total insulins in one leasing hospital with prices up to 3.4 fold higher than standard insulins. Overall, limited use of insulin glargine among hospitals in Northern Nigeria and in pharmacies again due to high prices. Appreciably higher use of long-acting insulin analogues

in Bangladesh enhanced by low cost biosimilars with increasing competition. Increased competition enhanced by local production can lower biosimilar costs enhancing future use of insulin glargine to the benefit of all diabetes patients requiring insulin.

Key words: Affordability, Bangladesh, diabetes, Kenya, long-acting insulin analogues, Nigeria

1. Introduction

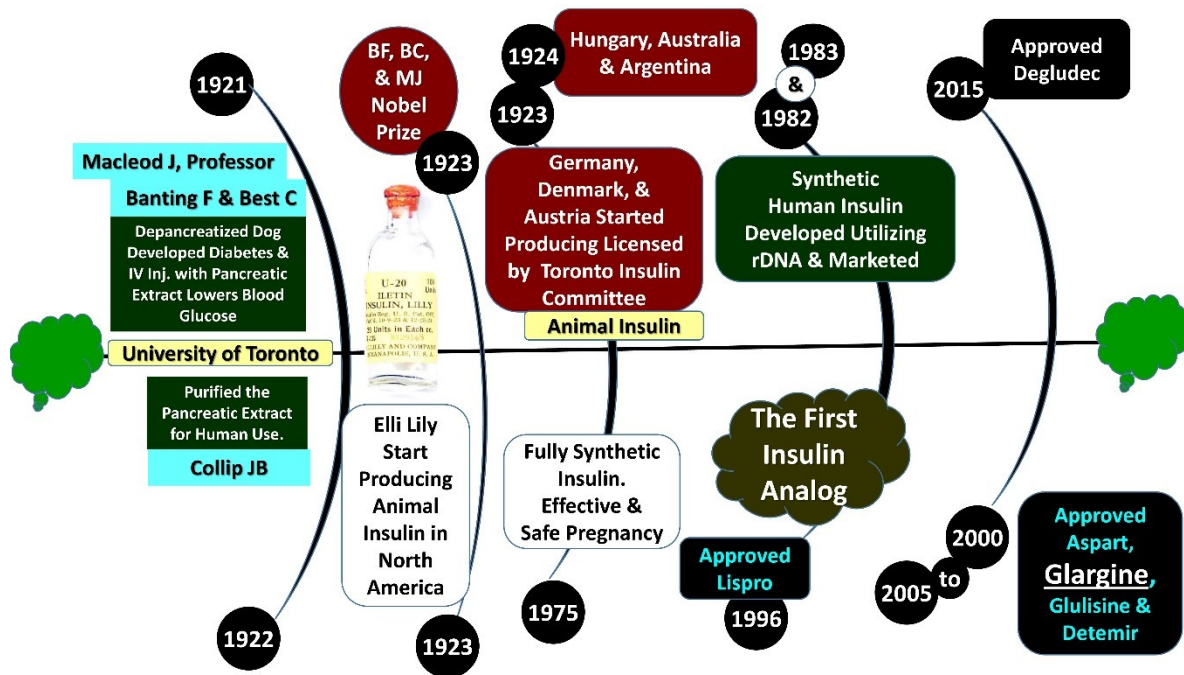
There is an estimated 451 to 463 million people worldwide with diabetes mellitus (Chan et al., 2021, Liu et al., 2020), with current growth rates likely to continue (Chan et al., 2021, Lin et al., 2020). This includes sub-Saharan Africa where the prevalence of diabetes is likely to reach 34.2 million by 2040, and rising up to 42 to 47 million patients across the whole of Africa by 2045 unless addressed (International Diabetes Federation, 2019a, Hamid et al., 2019, Godman et al., 2020a). We are seeing similar high prevalence and growth rates of patients with diabetes among Asian countries including Bangladesh, India, Malaysia and Pakistan ((Afroz et al., 2019, India State-Level Disease Burden Initiative Diabetes, 2018, International Diabetes Federation, 2019b, Rahim et al., 2020). Overall, low-and middle-income countries (LMICs) account for the vast majority of patients with diabetes world-wide (Chan et al., 2021, Lin et al., 2020), and this will continue.

These high and growing prevalence rates will have an appreciable impact on morbidity, mortality and health related costs among LMICs (Bommer et al., 2018, Chan et al., 2021, India State-Level Disease Burden Initiative Diabetes, 2018, Lin et al., 2020, Mapa-Tassou et al., 2019, Mutyambizi et al., 2018). This adds to the growing burden of non-communicable diseases (NCDs) across Asia and sub-Saharan Africa (Bigna and Noubiap, 2019, Gouda et al., 2019, Jakovljevic and Milovanovic, 2015, Rijal et al., 2018). This is critical especially among LMICs where there are high patient co-payments, and family members becoming ill can have catastrophic consequences for families (Aregbeshola and Khan, 2018, Khan et al., 2017, Murphy et al., 2020, Rijal et al., 2018). The impact of diabetes on morbidity, mortality and costs is exacerbated by associated microvascular and macrovascular complications. This includes blindness, non-traumatic lower-extremity amputations, chronic kidney disease as well as cardiovascular disease (Chan et al., 2021, Einarson et al., Gerstein, 2015, International Diabetes Federation, 2019b, Rwegerera et al., 2018). Typically, poor control of diabetes and its complications as well as hypoglycaemia contribute to this growing burden of diabetes (International Hypoglycaemia Study Group, 2019, Mbanya et al., 2020, Pillay et al., 2016). As a result, estimated costs associated with the management of patients with diabetes world-wide were up to US\$1.3 trillion in 2015, potentially rising to US\$2.1 to US\$2.5 trillion by 2030, equating to over 2% of Gross Domestic Product (GDP) (Bommer et al., 2018, Mapa-Tassou et al., 2019).

Alongside this, there are growing concerns generally regarding the management of patients with diabetes among African countries, especially those with high co-payment levels (Godman et al., 2020a, Godman et al., 2020b, Oponga et al, 2021a). This includes patients requiring insulin, which incorporates a growing proportion of patients with Type 2 diabetes (T2DM) in LMICs (Haque et al., 2021a, Oponga et al, 2021a, Venkataraman et al., 2020). Insulin has been in existence for almost 100 years to treat patients with diabetes (Figure 1) (Elliot et al, 2016, Barbetti and Taylor, 2019). However, there are concerns with the availability of insulin among LMICs, especially among African countries, exacerbated by high costs with currently only three pharmaceutical companies dominating the global market

in terms of overall utilisation and value (Beran et al., 2019, Beran et al, 2021, Ewan et al, 2019, Opanga et al, 2021a). This is leading to a number of activities to try and address issues of access and availability among African and other LMICs including the ACCISS (Addressing the Challenge and Constraints of Insulin Sources and Supply) initiative (Beran et al, 2018, Beran et al, 2019, Lontchi-Yimagou et al., 2017, Shannon et al., 2019).

Figure 1 – History of insulin



In Kenya, the costs of medicines to treat patients with diabetes and associated co-morbidities currently accounts for an average 52.4% of the total costs for those attending public healthcare facilities (Oyando et al., 2020). Such costs can have catastrophic consequences on families especially where insulin is needed. Concerns with access to pertinent medicines for patients with diabetes in Kenya, as well as misdiagnosed patients, has resulted in a number of projects in the country to address diagnostic and treatment concerns including the Base of Pyramid (BoP) project. The aim of the BoP project in Kenya is to improve the diagnosis of patients with diabetes as well as instigate a ceiling price for regular insulins such as insulin Mixtard® at KSh 500–600 (US\$5) per 1000IU among participating clinics and pharmacies to enhance the affordability of insulin, with this price equating up to a two-thirds price reduction (Shannon et al., 2019). This initiative builds on projects from other pharmaceutical companies in Kenya to help ensure that low cost medicines are available to treat patients with diabetes and their complications including hypertension (Mbui et al., 2017, Sandoz, 2015).

In Nigeria, the costs of medicines to treat patients with diabetes and its complications can be as high as 90% of total costs, much of which will be out-of-pocket (Fadare et al., 2015, Mutyambizi et al., 2018). As a result, discussing treatment costs is very important when physicians manage patients with NCDs in Nigeria to enhance the chances of patients purchasing and consuming their medicines as prescribed (Fadare et al., 2020). We are also seeing Novo Nordisk seeking to offer insulin free to children in Nigeria to again address concerns with access and affordability of insulins (Premium Times, 2020). Other donor and government activities across Africa to increase access to insulins include initiatives in Mozambique and Zambia. In these two countries, the International Insulin Foundation is

working with the governments to enhance access to insulin through addressing issues such as co-payments in community pharmacies (International Insulin Foundation, 2006). Alongside this, Biocon is looking to take part in a pan-African project entitled ‘Mission 10 cents’ starting in Tanzania whereby certain insulins will be sold at less than 10 US cents per day (Ndilwa, 2020). Such initiatives are likely to grow given the increasing burden of diabetes in Africa (Godman et al., 2020a, Godman et al., 2020b).

We are also seeing concerns with the management of diabetes among Asian countries including Bangladesh, India, and Pakistan (Ewen et al., 2019, India State-Level Disease Burden Initiative Diabetes, 2018, International Diabetes Federation, 2019b), where the affordability of medicines including those to treat patients with diabetes can be a critical issue (Datta et al., 2020, Gillani et al., 2018, Saeed et al., 2020). Affordability of insulins is a key issue when it comes to long-acting insulin analogues as their appreciably higher price than standard insulins such as Neutral Protamine Hagedorn (NPH) insulin has been a major concern in a number of LMICs (Almeida et al., 2018, Caires de Souza et al., 2014, Ewen et al., 2019, Department of Health Republic of South Africa, 2020). However, we are seeing growing use of long-acting insulin analogues in high and high-middle income countries, as well as Asian countries such as Bangladesh, in view of their documented benefits in reducing rates of hypoglycaemia, especially nocturnal hypoglycaemia, as well as improving adherence to insulin administration through improved patient comfort (Chan et al., 2021, Ewen et al., 2019, Haque et al., 2021a, Laranjeira et al., 2018, Pedersen-Bjergaard et al., 2014, Monami et al., 2009, Rys et al., 2015, Semlitsch et al., 2020, Tricco et al., 2021). It is therefore important to offer choices of different insulin preparations where possible to patients given concerns with sub-optimal adherence to insulin therapy and the implications (Davies et al., 2013, Peyrot et al., 2012, Spain et al., 2016). The patient benefits of long-acting insulin analogues are potentially further enhanced during religious festivals such as Ramadhan (Ahmed et al., 2017, Hassanein et al., 2017).

However, there can still be concerns with the potential health gain of long-acting insulin analogues versus NPH and other insulins (Hemmingsen et al., 2021). A number of studies though have shown that the higher acquisition costs of long-acting insulin analogues can potentially be offset by savings from averted costs elsewhere, which include the costs associated with hypoglycaemia, other diabetes-associated complications and potentially hospitalisation (Alemayehu et al., 2018, Lee et al., 2020, Shafie and Ng, 2020). The availability of lower-cost biosimilars should help with issues of affordability as seen generally across countries as well as with long-acting insulin analogues in Bangladesh (Haque et al., 2021a, Jensen et al., 2020, Moorkens et al., 2021).

The availability of low cost biosimilars should also be useful to African countries such as Kenya where despite long-acting insulin analogues being listed in the Kenyan Essential Medicine List (KEML) (Ministry of Health Republic of Kenya, 2019), there is limited use to date due to issues of affordability (Opanga et al., 2021a). This is particularly important among African countries with high levels of co-payment given the pressures on families when members become ill especially with chronic long-term non-communicable diseases (NCDs) (Aregbeshola and Khan, 2018, Godman et al., 2020a, Godman et al., 2020b). There are also concerns with the additional costs of long-acting insulin analogues compared to NPH and other similar insulins among LMICs including African countries such as Botswana, Namibia and South Africa with their universal healthcare systems, which also limits the funding and prescribing of long-acting within public clinics until procured prices appreciably fall (Godman et al., 2020b, Department of Health Republic of South Africa, 2020). However,

we are unaware of the situation regarding long-acting insulin analogues including biosimilars in Nigeria with currently high co-payments within their healthcare system to provide future direction. This is important in Africa given the size of the population in Nigeria versus a number of African countries and concerns generally with issues of affordability and compliance with medicines for patients with NCD (Aregbeshola and Khan, 2018, Fadare et al., 2020).

Consequently, we wanted to assess the current situation with respect to long-acting insulin analogues in Nigeria including biosimilars and potential strategies to enhance their use, especially biosimilars, where continued concerns with their value. This builds on the current situation in other LMICs with high patient co-payment levels including Bangladesh and Kenya (Haque et al., 2021a, Opanga et al., 2021a), and could build on discussions across Africa to stimulate local production of medicines following the recent COVID-19 pandemic combined with prequalification initiatives by the World Health Organisation (WHO) to stimulate competition to lower insulin prices (Ekeigwe 2019, Ogunleye et al., 2020, WHO, 2019). The findings can be used to provide guidance to the authorities in Nigeria and wider to enhance potential choices including long-acting insulin analogues where there are still concerns.

2. Materials and Methods

We adopted a mixed approach depending on the current situation within the chosen countries. This builds on similar research activities among other LMICs as well as previous research projects surrounding the utilisation and expenditure of medicines to treat patients with COVID-19 among African and Asian countries (Haque et al., 2021a, Haque et al., 2021b, Godman et al., 2020c, Kibuule et al., 2021, Opanga et al., 2021a, Sefah et al., 2021).

In the case of Nigeria, this involved approaching hospitals as well as community pharmacists to ascertain current utilisation and pricing levels for long-acting insulin analogues principally concentrating on insulin glargine as this was the only biosimilar available. We concentrated on Kano in Northern Nigeria for this initial research as the Kano metropolis is the commercial hub in Northern Nigeria and the second largest city in Nigeria with an estimated population of just under 4 million people. In addition, we have successfully undertaken similar projects in this metropolis (Haque et al., 2021b, Sefah et al., 2021).

The research was divided into two parts covering both hospitals and community pharmacies. We chose community pharmacies since patients in Nigeria typically purchase their medicines directly from such stores especially if there are medicine shortages within public hospitals, which can be frequent in Nigeria (Haque et al., 2021b, Fadare et al., 2020). The hospitals as well as community pharmacies and drug stores in Nigeria were purposely selected to provide relevant information to guide future discussions. There was no sample size calculations as our aim for this initial study was to gain greater understanding of the current situation with regards utilisation of insulins, especially long-acting insulin analogues, since we were unaware of any previous research in this area in Nigeria. This is similar to our previous study in Nigeria as well as other African countries regarding activities concerning the purchasing of medicines during the initial months following the recent COVID-19 pandemic (Haque et al., 2021b, Kibuule et al., 2021, Sefah et al., 2021).

Three hospitals in the Northern part of Nigeria were approached to assess total annual utilisation of long-acting insulin analogues (insulin glargine) versus short, medium and

longer-acting human insulins. These included Aminu Kano Teaching Hospital, Murtala Muhammad Specialist Hospital and Muhammadu Abdullahi Wase Specialist Hospital. In this study, utilisation data was depicted in packs to compare utilisation across the studied years. Alongside this, we collected data on utilisation (in terms of packs) and prices (initially in local currency) of long-acting insulin analogues from 11 community pharmacies and drug stores in Kano, Northern Nigeria, between 2019 and 2020. This is similar to the approach in Bangladesh as well as previously in Nigeria immediately following the COVID 19 pandemic (Haque et al., 2021a, Haque et al., 2021b). Defined daily doses (DDDs) were used in Kenya. Utilisation patterns in Nigeria will subsequently be compared to utilisation and expenditure patterns of the different insulin preparations, including insulin glargine, in Bangladesh and Kenya. This will be supplemented by the considerable knowledge of the senior level co-authors working across multiple African and Asian countries to provide future direction similar to other studies (Godman et al., 2020a, Godman et al., 2020c, Godman et al., 2020d, Haque et al., 2021c, Ogunleye et al., 2020, Sefah et al., 2021).

The findings in Bangladesh and Kenya have already been published (Haque et al., 2021a, Opanga et al., 2021a). These included the situation in both hospitals and community pharmacies in Bangladesh among both private and public hospitals (Haque et al., 2021b). Community pharmacies were approached in Bangladesh since there is limited dispensing of medicines among private hospitals in Bangladesh and only standard insulins such as NPH insulins are provided free of charge among public hospitals whilst stocks last (Haque et al., 2021a).

Community pharmacists were not approached in Kenya, unlike studies assessing the impact of COVID 19 on prescribing patterns for pertinent medicines, since if there was limited prescribing of long-acting insulin analogues among referral hospitals there would be limited or no dispensing in the community (Opanga et al., 2021a, Opanga et al., 2021b). The two hospitals chosen in Kenya for this initial study were Kenyatta National Hospital (KNH) and Embu County Referral Hospital (ECRH). Both KNH and ECRH are the largest public referral hospitals in their region, with KNH also offering quality specialized healthcare to patients across Kenya and wider (Kivoto et al., 2018, Opanga et al., 2021a). ECRH is located in Central Kenya where there is a high prevalence of diabetes mellitus (Opanga et al., 2021a).

We did not seek ethical approval as we were not dealing with patients, in line with national legislation and institutional guidelines (Godman et al., 2020c, Haque et al., 2021b, Haque et al., 2021c, Sefah et al., 2021). Besides, community pharmacists and drug store owners taking part in this study freely provided the requested information after being given the opportunity to refuse to participate if they wished. This is in line with previous studies undertaken by the co-authors in related areas. This includes analysis of policies to enhance the rational use of medicines and biosimilars, as well as pricing policies and issues surrounding biosimilars, generics and medicine shortages, all of which involved direct contact with key personnel (Godman et al., 2019, Godman et al., 2020a, Godman et al., 2020b, Godman et al., 2020d, Godman et al., 2020e, Miljković et al., 2020, Moon et al., 2014, Moorkens et al., 2021).

3. Results

We will first discuss changes in the utilisation of long-acting insulin analogues, principally insulin glargine, among the hospitals in Bangladesh, Kenya and Nigeria before discussing the situation seen among community pharmacies in Bangladesh and Nigeria.

Table 1 – Utilisation and pricing patterns for different insulin preparations among hospitals in Bangladesh, Kenya and Nigeria [Adapted from Haque et al., 2021a, Oponga et al., 2021a]

Country	Findings
Bangladesh	<ul style="list-style-type: none"> • The prescribing of long-acting insulin analogues among both private and public hospitals varied according to the hospital type as well as the prescribing physician • Typically, long-acting insulin analogues were prescribed more by endocrinologists than other physicians. However, the trend among all physicians is to increase the prescribing of long-acting insulin analogues in view of their perceived benefits • Among the participating hospitals: <ul style="list-style-type: none"> ○ Prescribing of long-acting insulin analogues varied from as low as 10 – 15% of all insulins prescribed up to a maximum of 45 – 50% ○ Prescribing of insulin glargine versus other long-acting insulin analogues varied from as low as 20 – 30% up to 80 – 90% of prescriptions ○ In the case of insulin glargine, prescribing of biosimilars ranged from 30 – 40% of all insulin glargine up to a maximum of 98% with growing prescribing of biosimilars in recent years
Kenya	<ul style="list-style-type: none"> • There was generally low prescribing of long-acting insulin analogues (glargine originator) among the two participating hospitals in Kenya in recent years • In KNH, this was only 0.5% of total insulins dispensed in 2015 reaching up to 3.4% to 3.6% of total insulin utilisation in 2019 and 2020. The impact on expenditure was greater – up to 8% of total insulin costs • In ECRH where Insulin Mixtard® was the principal insulin dispensed, with usage rising from 2061 packs in 2015 to 5627 packs in 2018 before falling to 4742 packs in 2019, with similar utilisation up to June 2020. There was no prescribing of any long-acting insulin analogue
Nigeria	<ul style="list-style-type: none"> • In 2019, dispensing of long-acting insulin glargine was limited versus standard insulins such as NPH insulin, and varied among the three chosen hospitals. • Overall, utilisation in 2019 ranged from 50 to 100 packs per year of 5x3ml 100IU/ml insulin glargine, with prices per pack ranging from N3600 (US\$9.47) to N4300 (\$11.42) • There were similar utilisation patterns among the three chosen hospitals in the first half of 2020 • There were marginal increases in prices on long-acting insulin glargine (originator) in recent years, with prices ranging from N4000 (US\$10.53), up from N3600, to N4500 (US\$11.84) in 2020 versus 2019

NB: KNH - Kenyatta National Hospital, ECRH - Embu County Referral Hospital (ECRH).

In view of the situation seen in KNH and ECRH (Table 1), it is likely there will be limited utilisation of insulin glargine generally throughout Kenya, with prices of insulin glargine 3.4 fold higher on a daily basis compared with soluble insulin and insulin Mixtard® and continuing issues of affordability (Ewen et al., 2019, Opanga et al., 2021a, Shannon et al., 2019). Prices of insulin glargine will need to fall considerably in Kenya to enhance its utilisation even among regional referral hospitals despite long-acting insulins being included in the Kenyan EML (Opanga et al., 2021a), which is similar to other African countries including Botswana, Nigeria and South Africa (Department of Health Republic of South Africa, 2020, Godman et al., 2020b, Opanga et al., 2021a).

Table 2 – Dispensing patterns for long-acting insulin analogues among community pharmacies in Bangladesh and Nigeria [Adapted from Haque et al., 2021a]

Country	Findings
Bangladesh	<ul style="list-style-type: none"> • Insulin analogues, including long-acting insulin analogues, were increasingly dispensed among the 167 community pharmacies and drug stores surveyed in Bangladesh in 2020 versus 2019 divided into four groups • Overall, insulin analogues were the principal insulin dispensed in over 40% of community pharmacies surveyed in one group in 2020, and this was increasingly the long-acting insulin analogues • Biosimilars were the principal insulin glargine dispensed in over 50% of this group pharmacies surveyed, reaching over 80% in 13% of those pharmacies surveyed • The biosimilars were the principal preparations of insulin glargine dispensed in a further set of 15 pharmacies accounting for just under 90% of all insulin glargine dispensed (2019 and 2020). There was a 16.7% increase in the number of insulin glargine packs dispensed in these 15 pharmacies between 2019 and 2020 • Prices for a number of the biosimilar insulin glargine preparations were over 50% below originator prices among pharmacies surveyed • The considerable variation in dispensing patterns seen for the various insulin glargine preparations depend on a number of issues including affordability and trust
Nigeria	<ul style="list-style-type: none"> • Among the 11 community pharmacies surveyed, the average number of packs of insulin glargine 100IU/ml dispensed in 2019 ranged from 35 to 110, with an average of 75 packs • There was a similar pattern in the first half of 2020 • Biosimilar Glaritus® only accounted for a small proportion of insulin glargine dispensed at under 10% in 2019 with similar low rates in 2020

Overall, insulin analogues, including long-acting insulin analogues, were increasingly dispensed among community pharmacies and drug stores in Bangladesh in 2020 versus 2019, accounting for over 50% of dispensed insulins among 46% of the 76 community pharmacies and drug stores surveyed in 2020 (Haque et al., 2021a). This was increasingly biosimilar

insulin glargine, accounting for over 50% of insulin glargine dispensed in 54% among 79 surveyed pharmacies and stores in 2020, with this trend continuing (Haque et al., 2021a). Biosimilars also accounted for just under 90% of dispensed insulin glargine in a further 15 surveyed community pharmacies in Bangladesh. The high rates of usage of insulin glargine biosimilars in Bangladesh in recent years was helped by price reductions of 50% or more for the biosimilars versus the originator, with currently no change in prices between 2019 and 2020 in the vast majority of pharmacies surveyed (Haque et al., 2021a). This contrasts with the low rates of biosimilar use in Nigeria (Table 2), reflecting general concerns with the quality of non-originator medicines in Nigeria (Fadare et al., 2016), as well as limited price differences in reality between originators and biosimilars, e.g., currently only a 4% difference between the biosimilar and the cheapest originator among the surveyed pharmacies.

Box 1 describes suggested activities that can be undertaken among LMICs with high co-payment levels to drive down costs of long-acting insulin biosimilars to improve patient access and choices building on the situation in Bangladesh.

Box 1 – Activities that can be undertaken by Governments and others to improve availability and use of long-acting insulin analogue biosimilars

- Increased competition among biosimilar manufacturers can potentially lower the prices of biosimilars as seen in Bangladesh and in other situations in other countries (Davio, 2018, Haque et al., 2021a, Jensen et al., 2020). Potential ways to achieve this include:
 - Governments and procurement agencies building on the WHO prequalification initiative to enhance imports of lower cost biosimilars from other LMICs to reduce the monopoly on current insulin manufacturers and respective prices (Beran et al., 2019, Beran et al., 2021, WHO, 2019)
 - Governments working with manufacturers and others to make good quality long-acting insulin analogues available at lower prices, building on initiatives among a number of countries in Africa (Dehayem et al., 2016, Lontchi-Yimagou et al., 2017, Sandoz, 2015, Premium Times, 2020, Schäfermann et al., 2020, Shannon et al., 2019). Alongside this, governments looking to enhance local/ regional production of biosimilars as seen in e.g. Malaysia (Biocon, 2021, Singh, 2019)
- Alongside this, for instance Pan-African consortia, with the help of WHO Africa and others, should seek to ensure where possible consistency in prices for biosimilar insulin glargine across Africa to reduce issues of parallel exportation and other concerns. Alongside this, Governments should review issues such as mark-ups of insulins to wholesalers and pharmacies to enhance their affordability where there are high co-payments. This especially as additional costs have ranged up to 565.8% for insulins among LMICs (Ball et al., 2019)
- Activities generally to enhance the utilisation of lower cost biosimilar long-acting insulins where approved and funded include:
 - Ministries of Health and/ or physicians groups enhancing local knowledge of the potential patient benefits where applicable with long-acting insulin analogues through studies as well as ensure the routine availability of biosimilar long-acting insulin analogues among all public health facilities especially hospitals/ clinics to reduce co-pays if patients have to pay for the insulin themselves in community pharmacies
 - This potentially involves key personnel within Ministries of Health and Physician/ Pharmacy Groups working together to collate ongoing clinical

evidence to support the continued use and funding of long-acting insulin analogues in pertinent patients

- Physicians and pharmacists (as well as nurse practitioners in primary healthcare clinics) should work with patients to ensure they are familiar with the different pens/ devices between different insulin glargine preparations if this is the case; however, reduced with national procurement practices
- Physician and Pharmacy Groups should look to monitor HbA1c and hypoglycaemia rates in patients prescribed long-acting insulin analogues to see if reduced rates of hypoglycaemia/ improved control are seen in practice, and subsequently broadcast any findings. Concurrent with this, key stakeholder groups should work with Governments and others to seek ways to enhance the routine availability of strips to improve home monitoring of blood glucose levels where there are continued concerns to improve patient care

4. Discussion

We believe this is the first study to compare utilisation and expenditure patterns for different insulin preparations, including long-acting insulin analogues, and their rationale, among middle-income countries with high patient co-payment levels. This is important compared with similar countries offering universal healthcare, whose goal is to maximise the health gain of their population within available resources. In this situation, health authorities are typically more active guiding physician prescribing to enhance the quality and efficiency of prescribing (Godman et al., 2014a, Godman et al., 2014b, Godman et al., 2021a, Meyer et al., 2017, Moon et al., 2014). This compares with situations where prescribing can be influenced by other factors including current incentives in the system enhancing inappropriate prescribing such as excessive use of injections, pharmaceutical companies encouraging the preferential prescribing of premium priced patented medicines versus considerably less expensive multiple sourced medicines without improving care in the absence of multiple demand-side measures as well as patient pressure enhancing the prescribing and dispensing of antibiotics for essentially viral infections (Godman et al., 2010, Godman et al., 2014b, Godman et al., 2019d, Soleymani et al., 2019, Mao et al., 2015, Zeng et al., 2015). Having said this, we are seeing sub-Saharan African countries such as Kenya looking to make sure appropriate facilities, medicines, and personnel, are in place to improve the management of their population with diabetes (Opanga et al., 2021). We are also seeing sub-Saharan African countries such as Namibia seek to establish pertinent quality indicators to improve the management of patients in ambulatory care especially those with NCDs including diabetes (Niaz et al., 2019).

With the growing prevalence of patients with diabetes requiring insulin, it is increasingly important that patients have a full range of different varieties of insulins available to improve their control of HbA1c levels, reduce hypoglycaemia including nocturnal hypoglycaemia, as well as generally improve adherence to prescribed insulins given current concerns (Opanga et al., 2021, Spain et al., 2016). This increasingly means routine access to long-acting insulin analogues at affordable prices where pertinent. Increased availability of lower cost biosimilars can help achieve this as seen in Bangladesh versus Kenya and Nigeria (Tables 1 and 2). Regions and countries can instigate a number of measures to engineer lower price for biosimilar insulin glargine to enhance their affordability and use (Box 1). This includes building on the WHO prequalification initiative, with increased competition likely to drive down the price of long-acting insulin analogues especially given the low production costs for insulin glargine (Gotham et al., 2018, WHO, 2019, Godman et al., 2021b). We have seen

increased competition drive down the price of biosimilars in other markets (Davio, 2018, Godman et al., 2021b, Jensen et al., 2020, Matuszewicz et al., 2015) providing examples to other countries. Alongside encouraging, increased local production of biosimilar insulin glargine similar to initiatives in Malaysia through Biocon or other companies (Singh, 2019), and building on current agreements include Aspen Pharmaceuticals producing vaccines for COVID-19 for South Africa and wider (Kew, 2021), should also help drive down prices. This also builds on suggestions put forward by the East African Secretariat to stimulate the production of medicines in Africa to help contain costs and reduce future shortages in future pandemics (EAC Secretariat, 2020, Ogunleye et al., 2020).

Once there is increased availability of low cost long-acting insulin analogue biosimilars, key stakeholder groups, including physician and pharmacy groups as well as patient organisations, will be necessary to educate physicians and patients regarding similar safety and effectiveness between originator and biosimilars if this is seen as a potential barrier to their use (Aladul et al., 2018, Blevins et al., 2020, Hadjiyianni et al., 2016, Lamb and Syed, 2018). However, this does not appear to be a problem in Bangladesh with increasing use of biosimilar insulin glargine (Haque et al., 2021a). We have also seen high use of biosimilar insulin glargine among some ambulatory care groups in the United Kingdom but not all due to concerns with different devices as well as limited price reductions (Agirrezabal et al., 2020, Aladul et al., 2018). Subsequently, routinely assess patients and medicine use during follow-up visits to ambulatory care clinics, including monitoring HbA1c levels and blood pressure, as well as the prescribing of medicines including statins given current concerns in LMICs with growing rates of complications among patients with diabetes (Chang et al., 2019, Madela et al., 2020, Mwita et al., 2019). The findings will enhance the knowledge base regarding long-acting insulin analogues, including biosimilars, among LMICs providing future direction.

We are aware of a number of limitations with our study. These include the fact that we only included a small number of hospitals and pharmacists in Nigeria, and only from one region in Nigeria. However, we have documented the rationale for our approach and believe our findings to date add to the knowledge base of the current prescribing of long-acting insulin analogues including biosimilars in Nigeria. We also only approached a limited number of hospitals in Bangladesh and Kenya, and did not approach pharmacies in Kenya for the reasons given. We also typically documented prescribing patterns and packages dispensed rather than DDDs in Bangladesh and Nigeria for the reasons given. However, despite these limitations we believe our findings are robust enabling us to make comprehensive recommendations regarding future activities among African and Asian countries to increase the availability and prescribing of long-acting insulin analogues.

5. Conclusion

In conclusion, it is encouraging to see growth in the prescribing and dispensing of long-acting insulin analogues, especially insulin glargine biosimilars, in Bangladesh enabling patients to benefit from their availability where pertinent. The high prices of long-acting insulin analogues, including insulin glargine, compared with standard insulins, including pre-mixed insulins, in Kenya and Nigeria needs to be urgently addressed to enhance their funding and use. This will include increased availability of lower cost biosimilars, potentially enhanced by prequalification and local production initiatives as well as other activities

Conflicts of interest and funding

The authors declare they have no competing interests.

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