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Assessing the management of patients with type 2 diabetes in Bangladesh during pre- and post-COVID-19 era and the implications: A pilot study

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ABSTRACT

There is growing concern with the management of patients with type 2 diabetes (T2DM) across countries with sub-optimal management increasing morbidity, mortality, and costs. In Bangladesh, the number of patients with diabetes will increase to an estimated 22.3 million by 2045, mainly T2DM, unless addressed. Alongside this, continued concerns with high rates of uncontrolled blood glucose levels as well as complication rates, including both microvascular and macrovascular complications in patients with T2DM in Bangladesh. This adds to the cost of care, which can be a concern among patients in Bangladesh with high co-payment rates. Alongside this, concerns with the impact of COVID-19 and associated lockdown measures on the care of these patients. Greater proactivity in managing these patients can help. Consequently, a need to ascertain what data is routinely collected in public hospitals in Bangladesh, including during the pandemic, to guide care. A pilot study was undertaken among eight patients in Chittagong Medical College using purposely designed case report forms to ascertain the extent of clinical information collected and their care against agreed target levels. There was typically poor control of blood glucose levels among the eight patients, which has resulted in increased prescribing of insulin. However, better control of blood pressure, lipids and urinary albumin levels. There were appreciable missing knowledge gaps, especially during the pandemic. This needs addressing.

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INTRODUCTION

General including the costs of care

There has been a growing number of patients with diabetes, including type 2 diabetes (T2DM), in Bangladesh in recent years, which has increased morbidity, mortality and health related costs (Afroz *et al*., 2019a). Fottrell *et al*. (2018) found that the combined prevalence of impaired glucose tolerance and fasting glucose levels,

as well as diabetes among adults in rural Bangladesh, was 26.1% and 34.9% among men and women, respectively, and prevalence rates in both genders increased with age. Among the elderly in Bangladesh, it was estimated that nearly 60% of those surveyed had at least one non-communicable disease including diabetes, with just under one-quarter had multiple co-morbidities (Mistry *et al*., 2021). Overall, it is estimated by Afroz *et al*. (2019a) that the number of patients with diabetes in Bangladesh will increase to 13.7 million by 2045 (Afroz *et al*., 2019a), which may well be an under-estimate given appreciable under-diagnosis of patients with diabetes in Southeast Asia including Bangladesh exacerbated by the recent COVID-19 pandemic (Kluge *et al*., 2020; Mistry *et al*., 2021; Shariful Islam *et al*., 2017). More recently, the International Diabetes Federation stated that there were already 13.1 million adults with diabetes in Bangladesh in 2021, with the number of people with diabetes in South East Asia expected to rise by 69% between 2021 and 2045 (IDF, 2021). This will equate to 22.3 million people in Bangladesh with diabetes by 2045 unless addressed, resulting in Bangladesh having the seventh highest prevalence rate for diabetes globally by then (IDF, 2021).

Alongside this, there are concerns with current management of patients with T2DM in Bangladesh in terms of a general lack of facilities and equipment to manage them (Rawal *et al*., 2019). There are also concerns with high rates of misdiagnosis, exacerbated by a lack of facilities in Bangladesh (Shariful Islam *et al*., 2017). Access to specialist diabetes services is also currently hindered in Bangladesh by time considerations including distances to travel to available clinics as well as often crowded conditions in clinics once patients arrive adding to the time taken to be seen. There are also concerns with associated costs of care with high co-payment levels in Bangladesh (Jennings *et al*., 2021). Alongside this, while locally available services are more accessible, they currently lack appropriate infrastructure as well as expertise to comprehensively manage patients (Jennings *et al*., 2021). Overall, even in specialist clinics in Bangladesh, there can be high rates of uncontrolled T2DM, especially among females and those with lower levels of education (Akter *et al*., 2019). These combined factors are a concern with high rates of complications seen among patients with T2DM, especially if uncontrolled (Afroz *et al*., 2019a, 2019b, 2019c; Akhter *et al*., 2013). Afroz *et al.* (2019c) in their study found prevalence rates of 10.1% and 30.5% for strokes and coronary artery disease, respectively, among patients with T2DM in Bangladesh, and 12.0%, 34.2%, 25.1%, and 5.8% of for diabetic foot alterations, nephropathy, retinopathy, and neuropathy, respectively.

These high complication rates increase the costs of care (Afroz *et al*., 2019b; Chan *et al*., 2021), which is important in Bangladesh due to high rates of patient co-payments (Haque *et al*., 2021a, 2021b; Khan *et al*., 2017; Rahman *et al*., 2020). Shariful Islam *et al*. (2017) estimated that in Bangladesh the total annual per capita expenditure on medical care was 6.1 times higher for patients with diabetes versus those without diabetes. The costs of medicines contribute most to the overall costs of treating patients with diabetes in Bangladesh (60.7%) followed by hospitalization costs (27.7%) (Afroz *et al*., 2019a). This can be an issue for patients as there are no national insurance programs in Bangladesh unlike among European and other countries providing universal healthcare, or discounted prices for medicines to treat diabetes mellitus and associated complications (Afroz *et al*., 2019a; Hamid *et al*., 2021). As a result, marginalized communities may struggle to fund their medication as well as pay to see a physician (Jennings *et al*., 2021).

However, greater proactivity in managing these patients in Bangladesh, enhanced by ongoing activities by the Government of Bangladesh, should bring considerable improvement in patient outcomes alongside net economic benefits given the current high costs of managing these patients (Afroz *et al*., 2019a). There are concerns though with the extent of monitoring and data routinely collected in public clinics in Bangladesh to adequately monitor patients with T2DM to reduce the extent of complications (Rawal *et al*., 2019).

Current management

The management of patients with diabetes in Bangladesh is increasingly orchestrated by the Diabetic Association of Bangladesh (BADAS), which was established in 1956. BADAS arranges diabetic healthcare via a number of establishments throughout Bangladesh incorporating a number of organizations. These include the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders, the National Health Care Network, Bangladesh University of Health Sciences, and the Health Care Development Projects as well as an appreciable number of affiliated associations in almost all the districts throughout Bangladesh alongside a few sub-districts (Azad, 2015; Khan *et al*., 2015). These organizations are typically heavily funded by the Government but operate as private organizations (Banglapedia, 2021). In addition, diabetic patients attending public hospitals do receive medicines, including traditional insulins, free of charge so long as supplies exists; however, this does not include long-acting insulin analogues (Godman *et al*., 2021a, 2021b; Haque *et al*., 2021b).

However, there are concerns with the routine availability of medicines to treat patients with diabetes, as well as routine laboratory and reporting systems, among clinics in Bangladesh (Biswas *et al*., 2018). These issues and concerns have been exacerbated by the instigation of lockdown and other measures to help control the spread of COVID-19, which impacts on the running of clinics as well as regular access and availability of medicines (Ahmed *et al*., 2020; Haque *et al*., 2020; Kluge *et al*., 2020; Mistry *et al*., 2021). Changes in lifestyles and diet through lockdown and other measures, coupled with reduced ability to visit clinics and pharmacies, have resulted in the worsening of glycemic values and outcomes in patients with T2DM (Eberle and Stichling, 2021; Hartmann-Boyce *et al*., 2020; Mohseni *et al*., 2021; Tewari *et al*., 2021). This though is not always the case with some studies showing no change in HbA1c levels or body weight pre- and post-lockdown (Sankar *et al*., 2020). To address concerns with patient management in Bangladesh, BADAS has published guidelines on aspects of care for patients with diabetes during the pandemic, including lifestyle advice (Diabetic Association of Bangladesh, 2020).

Study aims

In view of the current controversies and concerns, we sought to ascertain what data is routinely collected among patients with T2DM attending ambulatory clinics within public hospitals in Bangladesh. Secondly what impact, if any, did the COVID-19 pandemic have on the management of these patients building on published studies.

Most published studies regarding the management of patients with T2DM in Bangladesh have been prospective studies, including interview-based studies, rather than retrospective studies (Afroz *et al*., 2019b, 2019c; Rahman *et al*., 2020; Rawal *et al*., 2019; Shariful Islam *et al*., 2017). Consequently, such studies may not always fully capture the extent of care currently being provided to patients with T2DM attending public clinics in Bangladesh. These concerns are exacerbated by patients attending public clinics usually carrying their notes, including investigation reports, with them rather than these being stored, including electronically, within hospitals (Akter *et al*., 2021). Alongside this, COVID-19 itself may increase the potential for patients to develop T2DM (Maestre-Muñiz *et al*., 2021; Steenblock *et al*., 2021). Physicians may also only record advice, including lifestyle and dietary advice, if the patient is not complying. As a result, there could be concerns if patients see different physicians on different occasions and key activities are not recorded.

We were particularly interested in public hospitals due to high patient co-payment levels in Bangladesh (Khan *et al*., 2017; Rahman *et al*., 2020). Having said this, there is growing prescribing of long-acting insulin analogues in patients with diabetes in Bangladesh attending both public and private hospitals unlike the situation among patients in Africa attending public clinics (Godman *et al*., 2021a, 2021c; Haque *et al*., 2021a). This has been helped in Bangladesh by increased prescribing of lower cost long-acting insulin biosimilars, with increased competition helping to lower prices (Haque *et al*., 2021b).

The findings from this pilot study can subsequently be used to suggest improvements in the monitoring of patients with T2DM within public hospitals in Bangladesh to improve future care. In addition, potentially help with suggestions to improve the care of patients with T2DM among similar low- and middle-income countries (LMICs) with high co-payment levels.

MATERIALS AND METHODS

This was a retrospective pilot study of patients attending the outpatient clinic at Department of Endocrinology, Chittagong Medical College, Bangladesh. Chittagong Medical College is seen as a representative tertiary care hospital among the leading public hospitals in Bangladesh. This study builds on an earlier study in Chittagong documenting high prevalence rates of uncontrolled diabetes among those attending outpatient clinics (Akter *et al*., 2019).

A case report form (CRF) was developed to assess the level of clinical data usually captured during out-patient visits as well as any subsequent impact of COVID-19 lockdown measures on key outcome measures. Key measures include HbA1c, fasting plasma glucose (FPG), postprandial blood glucose (PPG), lipid levels (total cholesterol, HDL, LDL, and triglycerides), BP, serum creatinine, and urinary albumin as well as medicines prescribed for treating T2DM including insulins. In addition, the extent of micro- and macrovascular complications and other relevant complications including thyroid disorders. The final content of the CRF was based on the knowledge of the co-authors combined with published papers including a previous study conducted in Chittagong Medical College (Afroz *et al*., 2019c; Akter *et al*., 2019; Health Improvement Scotland, 2017; Mwita *et al*., 2019; Park and Pastakia, 2018). There was no contact with patients to clarify certain aspects of care including ongoing dietary and lifestyle changes incorporating exercise levels.

Current values of key parameters were also assessed against published targets (Table 1) to evaluate the level of care provided and the impact. Table 1 also contains details of the extent of complications and other key measures contained in the CRFs for this pilot study as well as any target levels where pertinent.

Just the names of the medicines prescribed for managing patients with T2DM, including those for complications incorporating cardiovascular medicines and statins, were recorded for this pilot study. There was no documentation of actual doses as this was outside the objectives of the study. There was also no recording whether the patients had any other co-morbidities in addition to the targeted comorbidities (Table 1).

The retrospective data collection started in December 2019, i.e., before the current COVID-19 pandemic and associated lockdown activities in Bangladesh (Godman *et al*., 2020a; Haque *et al*., 2020), and continued at 6-monthly intervals until November 2021. A 6-monthly interval was seen as optimal to monitor changes in key clinical measures (Table 1).

A pilot study was conducted among eight patients to assess the practicality of use of the CRF, with suggestions subsequently considered for improving the CRF before a full retrospective study would be undertaken in this and other clinics in Bangladesh.

Ethical approval

Ethical approval was obtained (CMC/PG/2021/232), and all patients gave verbal informed consent before starting the study.

RESULTS

Table 2 contains the characteristics of the eight patients with T2DM taking part in the pilot study. The employment status of patients was not included as this characteristic is typically not included within the patient's notes.

Table 3 contains details of key clinical parameters and treatments during their last visit (November 2021).

Table 4 contains a history of known complications in November 2021 building on Table 1.

Table 5 contains details of typical data sets available in the patient's notes in the studied period in accordance with Tables 3 and 4. Data sets not recorded are left out, which was typically clinical parameters including details of glycemic control, BP, and kidney function. The rationale for the visit was also variably recorded.

DISCUSSION

There was variable control of blood glucose levels among the eight patients with T2DM in November 2021 as measured by HbA1c, FPG, and PPG levels (Table 3). None of the eight patients had their PPG levels within target levels. Similarly, six out of seven patients had their FPG levels outside target levels (Table 1), and in one patient FPG levels were not recorded (Table 3). HbA1c levels was also above target levels in the majority of studied patients (Tables 1 and 3). This is similar to the findings of Akter *et al*.(2019) where 72% of studied patients with T2DM did not reach target HbA1c levels (Akter *et al*., 2019), and Afroz *et al*. (2019a) where 62.0% of patients with T2DM in their study had poor control and only 18.2% good control as measured by HbA1c levels. In addition, similar to concerns with

Table 1. Key clinical data sets included in the CRFs and potential targets.

Clinical data	Nature and targets
Glycaemic control	• Extent of control of T2DM including hypoglycemic episodes • An HbA1c target of 7.0% (53 mmol/mol) up to 7.9% among people with T2DM will reduce the risk of macrovascular and microvascular disease, with a target of 6.5% to 6.03% (48 mmol/mol) potentially more appropriate at diagnosis (Afroz *et al*., 2019b; Kaur *et al*., 2020; Mwita *et al*., 2019; Park and Pastakia, 2018; Rwegerera *et al*., 2021; Wang *et al*., 2011). • Alternatively, FPG levels ≥ 126 mg/dl down to 104 mg/dl for early diagnosis, which the use of FPG seen to identify more cases of patients with T2DM than HbA1c (Kaur *et al*., 2020; Wang *et al*., 2011) • Identified target levels for PPG are < 10.0 mol/l, with clinical studies showing that targeting PPG can further improve glycemic control (Blevins, 2011; NICE, 2018; Rwegerera *et al*., 2021)
Medicines prescribed for glycemic control (Godman *et al*., 2020b; Haque *et al*., 2021b; Health Improvement Scotland, 2017; Mwita *et al*., 2019; Rwegerera *et al*., 2019)	• Oral treatments for diabetes including metformin and sulphonyl ureas • Insulins including pre-mixed insulins and long-acting insulin analogues
Blood pressure (Grossman and Grossman, 2017; Mwita *et al*., 2019, 2020; NICE, 2019; Perkovic *et al*., 2016; Rwegerera *et al*., 2018)	Targets of BP in guidelines vary between <130/80 and <140/90 mmHg, with <140/90 mmHg typically predominant
Lipid profiles (Begum *et al*., 2019; Jellinger *et al*., 2017; Mwita *et al*., 2019; Rwegerera *et al*., 2021)	• Moderate risk - ≤2 risk factors and 10-year risk <100 mg/dl for LDL and <130 mg/dl for non-HDLc • Lipid profiles in Bangladesh are usually expressed in mg/dl. Target Total Cholesterol < 200 mg/dl, Target HDL > 40 mg/dl in males and >50 mg/dl in females, Target LDL < 100 mg/dl, Target TG < 150 mg/dl. Alternatively; LDL-C < 1.8 mmol/l, HDL-C < 1.0 for males and <1.3 mmol/l for female; triglycerides < 1.7 mmol/l, and total cholesterol < 4.5 mmol/l
Serum creatinine and urinary albumin (Aziz, 2015; Hasanato, 2016; Idowu *et al*., 2017; Norris *et al*., 2018; Perkovic *et al*., 2016; Rwegerera *et al*., 2018; Yokoyama *et al*., 2013)	• Chronic kidney disease (CKD) is one of the complications of patients with T2DM increasing cardio vascular and cerebrovascular disease and overall mortality unless addressed • Urinary albumin: creatinine ratio:3–30 mg/mmol OR 30–300 mg/g in a spot urine sample preferably in early morning sample. • Albuminuria is present when UACR is greater than 30 mg/g and is a marker for CKD • If albumin is present in routine and microscopic examination of urine (typically expressed as + or ++ or +++) this is considered as macroalbuminuria
Microvascular complications (Afroz *et al*., 2019b; Akhter *et al*., 2013; Chan *et al*., 2021; Hoque *et al*., 2017; Jelinek *et al*., 2017)	• Retinopathy, Nephropathy and Neuropathy • Assessments based on clinical experience • These complications are usually written in the patient's notes. If not explicitly written, investigation reports are often used to help with a diagnosis
Macrovascular complications (Akhter *et al*., 2013; Chan *et al*., 2021; Jelinek *et al*., 2017)	• Cardiovascular disease, cerebrovascular disease, peripheral arterial disease, diabetic foot ulcerations • Assessments based on clinical experience and again if investigations are included in the notes
Hospitalizations (Afroz *et al*., 2019b)	• History of hospitalizations • Rationale—recorded in patients' discharge notes from the hospital
Any other co-morbidities/ complications (Gläser *et al*., 2015; Zhang *et al*., 2021)	This could include hypertension, bronchial asthma, chronic obstructive pulmonary disease (COPD), hypothyroidism, and hyperthyroidism

FPG = Fasting plasma glucose; HDL = High-density lipoprotein; LDL = Low-density lipoprotein; PPG = Postprandial plasma glucose; T2DM = Type 2 diabetes; UACR = Urine albumin-to-creatinine ratio.

increasing blood glucose levels among patients with T2DM as a result of the pandemic (Eberle and Stichling, 2021; Tewari *et al*., 2021). In a separate study, Afroz *et al*. (2019c) found key factors associated with complications of T2DM included being female, older, having a low level of education, living in an urban area, having poor dietary habits and poor adherence to prescribed treatments, physical inactivity and a longer duration of diabetes. There appeared though to be better control of BP, lipid levels, and urinary albumin levels among the eight studied patients (Table 3). However, there was no recording of lipid levels in the notes of an appreciable number of patients.

Table 2. Key patient characteristics among the eight patients.

Patient	Gender	Marital status
Patient 1	Male	Married
Patient 2	Male	Married
Patient 3	Female	Widowed
Patient 4	Male	Married
Patient 5	Female	Married
Patient 6	Female	Married
Patient 7	Male	Married
Patient 8	Male	Married

Table 3. Key clinical parameters and treatments among the eight patients in November 2021.

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8
Rationale for the visit	Routine FU; infection	Routine FU; uncont DM	Uncont DM; hypo	Routine FU; uncont DM,	Routine FU	Routine FU	Regular FU; uncont DM; Infection	NR
Other illnesses	Not present	CVD	Not present	Peptic ulcer disease	Multiple abscesses	Not present	Left renal stone	IHD; hyperthyroidism
Clinical parameters								
BMI kg/m2	NR	22.4	20.0	23.3	22.9	29.2	22	NR
FPG mmol/l	21.1	18.72	18.8	NR	8.3	15.5	6.6	9.5
PPG mmol/l	27.2	26.22	27.5	NR	12.6	23.0	13.7	11.1
HbA1c%	NR	14.4%	16.2%	7.3%	NR	11.1	8.1	8.5
TC mg/dl	255	185	NR	NR	NR	211	119	NR
HDL mg/dl	32	41	NR	NR	NR	30	41	NR
LDL mg/dl	156	139	NR	NR	NR	136	79	NR
TG mg/dl	342	141	NR	NR	NR	325	100	NR
BP (mmHg)	160/110	130/86	110/70	120/80	160/100	120/100	NR	110/80
Serum creatinine mg/dl	1.27	0.88	0.9	0.8	1.2	NR	1.4	1.3
Urinary albumin	++	Absent urinary albumin	NR	NR	NR	NR	Absent albumin	NR
Treatment								
Oral anti-diabetic medication	Metformin, SGLT2i	Metformin	Metformin	None prescribed	Metformin	Metformin	Metformin; Gliclazide	Metformin
Insulin	Regular and Intermediate acting insulin	Regular and intermediate	Regular and long-acting analogues	Regular and long-acting insulin analogues	Regular	Regular, intermediate	Regular; intermediate	Not prescribed
CV medicines	Olmesartan, aspirin	Aspirin	Antiplatelets aspirin	Spironolactone propranolol	Losartan, bisoprolol, aspirin	Olmesartan; bisoprolol	Bisoprolol	Bisoprolol; aspirin; clopidogrel; nitro-glycerine
Statins	Yes	Yes	Yes	Not prescribed	Yes	Yes	Yes	Yes

Routine FU = routine follow-up visit; uncon DM = uncontrolled T2DM; NR = not recorded.

Not surprisingly in view of concerns with blood glucose levels, there was increased prescribing of insulin in the majority of the studied patients alongside the prescribing of a sensitizer such as metformin. In addition, the routine prescribing of cardiovascular medicines including statins (Table 3) to help reduce the extent of macrovascular complications. Encouragingly as well, there appeared to be greater availability and prescribing of medicines to help control blood glucose levels as well as prevent cardiovascular complications compared with the situation in many other LMICs (Flood *et al*., 2021; Manne-Goehler *et al*., 2019; Mwita *et al*., 2020).

Despite this, microvascular and macrovascular complications did develop in a number of the studied patients (Table 4) although this was not always recorded. This is a concern given the costs associated with such complications, adding to the overall costs of managing patients with diabetes in Bangladesh (Afroz *et al*., 2019a; Chan *et al*., 2021; Moucheraud *et al*., 2019; Shariful Islam *et al*., 2017), and should be the target for future quality improvement programs. Key target areas include increasing the percentage of patients reaching target blood glucose and other targets (Table 1) to prevent subsequent complications. However, this will require changes in the way data is routinely collected in public hospitals in Bangladesh given current concerns (Tables 3–5) to reduce diabetes related complications (Chamnan, 2021; Manne-Goehler *et al*., 2019). In addition, the development of country specific guidelines with regular updates, cognizant of the situation within a country, especially with issues of availability and affordability of medicines as well as pharmacogenetic issues as seen in the case of managing hypertension in certain groups of people (Jellinger *et al*., 2017; Mbui *et al*., 2017; Owolabi *et al*., 2018). There are also concerns regarding the dissemination, publication of regular updates, and follow-up of adherence to guidelines among physicians treating patients with T2DM in Bangladesh, with adherence to guidelines known to improve the quality of care provided (Campbell *et al*., 2021; Niaz *et al*., 2019; Owolabi *et al*., 2018). This needs to be addressed going forward.

It did appear as if the current COVID-19 pandemic interfered with out-patient clinics as seen by large gaps in patient follow-up, which needs to be improved going forward (Tables 3 and 5). This is starting to be addressed as seen by the increase in patient data being collected in November 2021 versus

Table 4. Noted complications in November 2021 among the eight patients.

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8
Microvascular	Nephropathy, Neuropathy	No	No	No	NR	Nephropathy	Nephropathy	No
Macrovascular complications	No	Stroke	No	No	Stroke	NR	No	CVD
Others (included listed Table 1)	No	No	COPD; Fibroid uterus; left renal cyst	Cholelithiasis	N0	Fibroid uterus; ovarian cyst; NAFLD	UTI	COPD; hyperthyroidism
Hospitalisations	No	Yes—uncontrolled DM	Yes—DM and adenocarcinoma of Right Lung	Yes—Peptic ulcer disease	Yes—multiple abscesses	Yes—uncontrolled DM	Yes—uncontrolled DM, UTI	Yes—hyperthyroidism
Other complications/ comorbidities	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

CVD = cardiovascular disease; COPD = Chronic obstructive pulmonary disease; DM = diabetes mellitus; NAFLD = Non-alcoholic fatty liver disease; NR = Not recorded; PVD = peripheral vascular disease; UTI = Urinary tract infection.

Table 5. Key data actually recorded and available to track patient care December 2019 to June 2021.

Patient	Dec 2019	June 2020	Dec 2020	June 2021
Patient 1	Rationale for the visit; metformin and gliclazide; history of hospitalizations	Rationale for the visit; metformin and gliclazide; history of hospitalizations; complications	Rationale for the visit; metformin and gliclazide; history of hospitalizations, complications	Rationale for the visit; metformin and gliclazide; history of hospitalizations, complications
Patient 2	Rationale for visit; metformin and insulins; history of hospitalization; complications and co-morbidities	Rationale for visit; metformin and insulins; history of hospitalization; complications and co-morbidities	Rationale for visit; metformin and insulins; history of hospitalization; complications and co-morbidities	Rationale for visit; metformin and insulins; history of hospitalization; complications and co-morbidities
Patient 3	Metformin, gliclazide and DPP4i; aspirin; hospitalizations; complications	Metformin, gliclazide and DPP4i; aspirin prescribed; hospitalizations; complications	Metformin, gliclazide and DPP4i; aspirin; hospitalizations; complications	Metformin, gliclazide and DPP4i; aspirin; hospitalizations; complications
Patient 4	Metformin; spironolactone and propranolol; hospitalizations and complications	Metformin prescribed; rationale for the visit; spironolactone and propranolol; hospitalizations and complications	Metformin; spironolactone and propranolol; hospitalizations and complications	Rationale for the visit; spironolactone and propranolol; hospitalizations and complications
Patient 5	Metformin; atenolol; hospitalizations; complications (some)	Metformin; atenolol, hospitalizations; complications (some)	Blood pressure; metformin; atenolol; hospitalizations; complications (some)	Other illnesses; blood pressure; metformin and insulin; atenolol and aspirin, prescribed
Patient 6	Metformin; amlodipine; hospitalizations; complications and co-morbidities	Rationale for the visit; BMI; metformin; amlodipine; hospitalizations; complications and co-morbidities	Metformin; amlodipine; complications; hospitalizations; complications and co-morbidities	Rationale for the visit; BP; metformin and insulin; amlodipine; hospitalizations; complications and co-morbidities
Patient 7	Rationale for the visit; metformin and gliclazide; bisoprolol; complications;	Rationale for the visit; metformin and gliclazide; bisoprolol; complications	Rationale for the visit; metformin and gliclazide; bisoprolol; complications	Rationale for the visit; metformin and gliclazide; bisoprolol; complications;
Patient 8	Hospitalization; complications	Hospitalization; complications	Hospitalization; complications	Rationale for the visit; metformin; bisoprolol, aspirin, clopidogrel and nitroglycerine; hospitalization; complications

previous studied periods following the start of the pandemic (Table 3). The instigation of electronic data sets is one way forward, building on the situation in other countries (Kerkenbush and Lasome, 2003; Kaufman, 2010). In the meantime, re-looking at the current situation to improve patient monitoring and adherence to prescribed medicines including those to prevent cardiovascular diseases and lifestyle advice (Godman *et al*., 2020b). This could include greater use of mobile technologies to improve the education of patients with T2DM, establishing digital support groups, as well as routine collection of key clinical parameters when clinic visits are a concern (Ranscombe, 2020).

We are aware of developments such as continuous glucose monitoring and the use of insulin pumps to further improve the care of patients with T2DM (Edelman *et al*., 2018; Janapala *et al*., 2019;

Mardare *et al*., 2021; Wright and Hirsch, 2017). However, there are issues with affordability across LMICs (Mardare *et al*., 2021). In the meantime, the focus in LMICs should be on improving the care of patients with T2DM to reduce the potential for insulin in the first place as well as macrovascular complications (Godman *et al*., 2021c). This includes re-looking at issues such as data collection and analysis through electronic systems.

We are aware of a number of limitations with this study. This includes the fact that this is only a pilot study. In addition, it is a retrospective study subject to the typical data collection limitations of retrospective studies. Nevertheless, we believe our findings give guidance regarding potential ways to improve the care of patients with T2DM in the public health system in Bangladesh, and we will be taking this forward in future studies.

CONCLUSION

There are concerns with the management of patients with T2DM in Bangladesh; however, the outcomes of care of patients with T2DM in this pilot study appear to be better compared with a number of LMICs. However, there is considerable room for improvement to reduce future complications, including both microvascular and macrovascular complications. Improved data collection and monitoring of patients can improve the future care of patients with T2DM in the public system in Bangladesh and reduce subsequent complications in a cost-effective way. Enhancing the availability of clinics and services, including earlier diagnosis, in the public system should help to further improve the care of patients with T2DM in Bangladesh. This should be a priority, especially as we are celebrating 100 years of insulin discovery.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the content of the paper including conception, acquisition and interpretation of the data, critically reviewing successive drafts; agreed to submit to the current journal and approving the version to be published. In addtion, FA, MH and BG were accountable for all aspects of the work. All the authors are eligible to be an author as per the international committee of medical journal editors (ICMJE) requirements/guidelines.

ETHICAL APPROVALS

Ethical approval was obtained (CMC/PG/2021/232), and all patients gave verbal informed consent before starting the study.

DATA AVAILABILITY

All data generated and analyzed are included within this research article.

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