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

Farhana Akter¹, Mainul Haque²*, Sanira Akter¹, Gias Uddin¹, Naim Chy³, Francis Kalemeera⁴, Amanj Kurdi⁵,⁶,⁷,⁸, Kona Chowdhury⁹, Brian Godman⁵,⁸,¹⁰

¹Department of Endocrinology, Chittagong Medical College, Chittagong, Bangladesh.
²Unit of Pharmacology, Faculty of Medicine and Defence Heath, Universiti Pertahanan Nasional Malaysia (National Defence University of Malaysia) Kem Perdana Sungai Besi, 57000 Kuala Lumpur, Malaysia.
³Department of Health Economics, University of Chittagong, Chittagong, Bangladesh.
⁴Department of Pharmacy Practice and Policy, Faculty of Health Sciences, School of Pharmacy, University of Namibia, Windhoek, Namibia.
⁵Department of Pharmacoepidemiology, Strathclyde Institute of Pharmacy and Biomedical Science, University of Strathclyde, Glasgow, UK.
⁶Center of Research and Strategic Studies, Lebanese French University, Erbil, Iraq.
⁷Department of Pharmacology and Toxicology, College of Pharmacy, Hawler Medical University, Erbil, Iraq.
⁸Division of Public Health Pharmacy and Management, School of Pharmacy, Sefako Makgatho Health Sciences University, Pretoria, South Africa.
⁹Department of Pediatrics, Gonoshasthaya Samaj Vittik Medical College and Hospital, Dhaka, Bangladesh.
¹⁰Centre of Medical and Bio-Allied Health Sciences Research, Ajman University, Ajman, United Arab Emirates.

ARTICLE INFO
Received on: 08/12/2021
Accepted on: 12/02/2022
Available Online: 05/05/2022

Key words:
Bangladesh, complications, diabetes, guidelines, health policies, type 2 diabetes.

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.

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 underestimate 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 above target levels in three 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.

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 above target levels in three 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.
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 1. Key clinical data sets included in the CRFs and potential targets.

<table>
<thead>
<tr>
<th>Clinical data</th>
<th>Nature and targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycaemic control</td>
<td>• Extent of control of T2DM including hypoglycemic episodes</td>
</tr>
<tr>
<td></td>
<td>• 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).</td>
</tr>
<tr>
<td>Blood pressure (Grossman and Grossman, 2017; Mwita et al., 2019, 2020; NICE, 2019; Perkovic et al., 2016; Rwegerera et al., 2018)</td>
<td>• 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)</td>
</tr>
<tr>
<td>Lipid profiles (Begum et al., 2019; Jellinger et al., 2017; Mwita et al., 2019; Rwegerera et al., 2021)</td>
<td>• Identified target levels for PPG are ≤ 10.0 mmol/l, with clinical studies showing that targeting PPG can further improve glycemic control (Blevins, 2011; NICE, 2018; Rwegerera et al., 2021)</td>
</tr>
<tr>
<td>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)</td>
<td>• Oral treatments for diabetes including metformin and sulphonyl ureas</td>
</tr>
<tr>
<td></td>
<td>• Insulins including pre-mixed insulins and long-acting insulin analogues</td>
</tr>
<tr>
<td>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)</td>
<td>• Targets of BP in guidelines vary between &lt;130/80 and &lt;140/90 mmHg, with &lt;140/90 mmHg typically predominant</td>
</tr>
<tr>
<td>Lipid profiles in Bangladesh are usually expressed in mg/dl. Target Total Cholesterol &lt; 200 mg/dl, Target HDL &gt; 40 mg/dl in males and &gt;50 mg/dl in females, Target LDL &lt; 100 mg/dl, Target TG &lt; 150 mg/dl. Alternatively; LDL-C &lt; 1.8 mmol/l, HDL-C &lt; 1.0 for males and &lt;1.3 mmol/l for female; triglycerides &lt; 1.7 mmol/l, and total cholesterol &lt; 4.5 mmol/l</td>
<td>• Moderate risk - ≤2 risk factors and 10-year risk &lt;100 mg/dl for LDL and &lt;130 mg/dl for non-HDLc</td>
</tr>
<tr>
<td></td>
<td>• Lipid profiles</td>
</tr>
<tr>
<td>Serum creatinine and urinary albumin</td>
<td>• Urinary albumin: creatine ratio;3–30 mg/mmol OR 30–300 mg/g in a spot urine sample preferably in early morning sample.</td>
</tr>
<tr>
<td></td>
<td>• Albuminuria is present when UACR is greater than 30 mg/g and is a marker for CKD</td>
</tr>
<tr>
<td></td>
<td>• If albumin is present in routine and microscopic examination of urine (typically expressed as + or ++ or ++++) this is considered as macroalbuminuria</td>
</tr>
<tr>
<td>Microvascular complications (Afroz et al., 2019b; Akhter et al., 2013; Chan et al., 2021; Hoque et al., 2017; Jellinek et al., 2017)</td>
<td>• Retinopathy, Nephropathy and Neuropathy</td>
</tr>
<tr>
<td></td>
<td>• Assessments based on clinical experience</td>
</tr>
<tr>
<td></td>
<td>• These complications are usually written in the patient’s notes. If not explicitly written, investigation reports are often used to help with a diagnosis</td>
</tr>
<tr>
<td>Macrovascular complications (Akhter et al., 2013; Chan et al., 2021; Jellinek et al., 2017)</td>
<td>• Cardiovascular disease, cerebrovascular disease, peripheral arterial disease, diabetic foot ulcerations</td>
</tr>
<tr>
<td></td>
<td>• Assessments based on clinical experience and again if investigations are included in the notes</td>
</tr>
<tr>
<td>Hospitalizations (Afroz et al., 2019b)</td>
<td>• History of hospitalizations</td>
</tr>
<tr>
<td></td>
<td>• Rationale—recorded in patients’ discharge notes from the hospital</td>
</tr>
<tr>
<td>Any other co-morbidities/ complications (Gläser et al., 2015; Zhang et al., 2021)</td>
<td>This could include hypertension, bronchial asthma, chronic obstructive pulmonary disease (COPD), hypothyroidism, and hyperthyroidism</td>
</tr>
</tbody>
</table>

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.

### Table 2. Key patient characteristics among the eight patients.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Marital status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>Male</td>
<td>Married</td>
</tr>
<tr>
<td>Patient 2</td>
<td>Male</td>
<td>Married</td>
</tr>
<tr>
<td>Patient 3</td>
<td>Female</td>
<td>Widowed</td>
</tr>
<tr>
<td>Patient 4</td>
<td>Male</td>
<td>Married</td>
</tr>
<tr>
<td>Patient 5</td>
<td>Female</td>
<td>Married</td>
</tr>
<tr>
<td>Patient 6</td>
<td>Female</td>
<td>Married</td>
</tr>
<tr>
<td>Patient 7</td>
<td>Male</td>
<td>Married</td>
</tr>
<tr>
<td>Patient 8</td>
<td>Male</td>
<td>Married</td>
</tr>
</tbody>
</table>
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 (Jelinger 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 3. Key clinical parameters and treatments among the eight patients in November 2021.

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

Routine FU = routine follow-up visit; uncon DM = uncontrolled T2DM; NR = not recorded.
### Table 4. Noted complications in November 2021 among the eight patients.

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

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.

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

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; Ranscombe, 2020). 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).

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).
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.

FUNDING

There was no funding for this study or the write up of the study.

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 addition, 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.

PUBLISHER’S NOTE

This journal remains neutral with regard to jurisdictional claims in published institutional affiliation.

REFERENCES


Chamman P. Achieving sensible targets for a diabetes care cascade in LMICs. Lancet Glob Health, 2021; 9:e1481–2; doi:10.1016/S2214-109X(21)00403-4


---

How to cite this article: