



IMPORTANCE OF DIABETES MANAGEMENT DURING THE COVID-19 PANDEMIC IN MAKKAH AL-MUKARRAMAH SAUDI ARABIA

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Abstract:

Background:

The emergence of severe acute respiratory syndrome coronavirus 2 (SARSCoV2), and the subsequent announcement by the World Health Organization of a global pandemic, has altered health care across the public and private sectors. Clearly, coronavirus disease 2019 (COVID-19) is having a huge impact on general practitioners, emergency physicians, respiratory physicians, intensivists and related staff and is also impacting the day-to-day delivery of chronic health care. Conditions such as type 1 and type 2 diabetes require regular, usually face-to-face contact with GPs, endocrinologists, diabetes educators, dieticians and podiatrists to optimize glycemic control. However, with recommendations regarding social isolation to minimize spread of COVID-19, the delivery of such health care is increasingly being delivered using telehealth. This has been greatly facilitated in the Saudi Arabia, Because of the threat that COVID-19 poses to people with hyperglycemia and diabetes, the need for effective management in the outpatient setting is paramount, and the role of the PCP in limiting the risk of severe COVID-19 disease through effective management of blood glucose is crucial. Uncontrolled diabetes and/or hyperglycemia is associated with severe COVID-19 disease and increased mortality.

Aim of the study: To assess the importance of diabetes management during the COVID-19 pandemic in Makkah Al-Mukarramah Saudi Arabia.

Method: cross sectional study conducted about importance of diabetes management during the COVID-19 pandemic in Makkah among patients attending primary healthcare centers in Makkah City in 2022. Our total participants were (200)

Results: shows that most of the participants (35.0%) were in the age group 35-45 years. majority of them were male (53.0%). Educational level the majority of participant are high education were(37.0%) also nationality the majority of participant are Saudi were(75.0%). while smoker were(39.0%).

Conclusion: The availability of several COVID-19 vaccines has provided hope that high COVID-19 infection rates will be brought under control in the coming months. However, with concerns over new variants and overwhelmed healthcare systems, it remains vitally important to preserve the health of those who are most at risk of diabetes disease. Further, despite encouraging initial reports of the effectiveness of vaccines in older adults, the effectiveness in those with diabetes who may have compromised immune systems remains to be seen

Keywords: Diabetes type 2, management, COVID-19, Makkah , Al-Mukarramah.

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Introduction

A Pragmatic Approach to Inpatient Diabetes management during the COVID-19 Pandemic. The coronavirus disease 19 (Covid-19) global pandemic is an on-going public health catastrophe that has infected >25 million individuals and has resulted to >840,000 casualties as of August 30, 2020, based on John Hopkins University's interactive web-based dashboard to track COVID-19 in real time [1,2]. Among the Gulf Cooperation Council (GCC) countries, Saudi Arabia holds the record with the highest number of cases (>340,000) and deaths (>5200) [3]. While management of Covid-19 is generally supportive care in nature, different countries do not follow the same protocols and are considered living guidance since they are constantly subject to change. Saudi Arabia is no different, and hospitals in the country follow the most updated version (July 31, 2020) issued by the Ministry of Health (MoH) [4]. The pandemic of COVID-19 has presented new challenges to primary health care personnel providing care for infected patients with diabetes who represent high percentage of critically ill patients in health care.[5] health care sector pirate glycemic management contributes to a reduction in adverse clinical outcomes in acute illness but also requires intensive patient interactions for bedside glucose monitoring, intravenous and subcutaneous insulin administration, as well as rapid intervention for hypoglycemia events. These tasks are required at a time when minimizing patient interactions is recommended as a way of avoiding prolonged exposure to COVID-19 by health care personnel who often practice in settings with limited supplies of personal protective equipment[6].

Currently, many observational studies have emerged from different countries in identifying risk factors and associations with Covid-19 severity. A consistent risk factor associated with Covid-19 mortality is old age, which has been singled out by both the World Health Organization (WHO) and the Centers for Disease and Control (CDC) as the most vulnerable population from Covid-19 [8]. While this may also be the case for Saudi Arabia, the country is fortunate to have a relatively young population, but it is also replete with other risk factors associated with old age such as diabetes mellitus (DM), hypertension and obesity [9], making the population potentially more susceptible for worse Covid-19 outcomes. Another unique feature in Saudi Arabia, which is also true for the GCC region, is the abundance of migrant labor workers, mostly men, coming less developed countries such as North Africa and South Asia, the latter of which were recently observed to also have

their own share of increasing prevalence of cardio metabolic diseases [10]. In the first national study on Covid-19 done in the country, 46.6% of the 1519 individuals who tested positive from SARS-CoV2 were non-Saudis [11]

Further, it is now known that poor glucose control can be associated with a high risk of death [13]. With the approval of two mRNA vaccines by Pfizer-Bio NTech and Moderna, and of the Johnson & Johnson adenovirus vaccine, there is hope on the horizon that the pandemic is being brought under control. However, genetic variants of the virus have been circulating throughout the pandemic. Variants of concern are classified as those for which there is evidence of an increase in transmissibility [14,15], more severe disease (e.g. increased hospitalizations or deaths), a significant reduction in neutralization by antibodies generated during previous infection or vaccination, reduced effectiveness of treatments or vaccines [16], or diagnostic detection failures. At present, according to the Centers for Disease Control and Prevention, are classified as variants of concern [17].

Literature Review

Barron, et al. (2020) found that in the era of COVID-19, having diabetes and hyperglycemia is associated with poorer outcomes and more severe disease. A meta-analysis of 1558 patients from six studies identified diabetes as one of several comorbidities (including hypertension, chronic obstructive pulmonary disease, cardiovascular disease, and cerebrovascular disease) that are major risk factors for COVID-19 [18]. Having diabetes has been linked with increased mortality, longer hospitalization, and more severe disease after COVID-19 infection [19]. Recent data have shown that both type 1 diabetes (T1D) and type 2 diabetes (T2D) are independent risk factors for increased mortality with COVID-19 [20].

Shi et al. (2020) data from a large scale, multi-center, retrospective study in Wuhan involving 1561 Covid-19 patients described the presence of DM as not independently associated with in-hospital deaths [21].

Nasser, et al. (2021) report that thanks to telemedicine, several patients with diabetes during the COVID-19 pandemic and chronic diseases were able to avoid exposure to the COVID-19 infection in healthcare settings and receive their management, diagnosis, treatment, and monitoring at home. Although telemedicine can offer a wider coverage of healthcare, individuals who are not familiar with technologies, those who do not have broadband fast internet, illiterate people, older adults, and people with specific disabilities such as

hearing loss and blindness may find difficulties in using telemedicine services [22,23]

Suleyman et al. (2020) A more recent evidence in the US involving 463 Covid-19 also support the lack of association between DM and mortality, as well as risk for ICU admission and mechanical ventilation [24].

Principal investigator, Mikhail Kosiborod, to conclude that 'the results do not support discontinuation of SGLT2 inhibitors in this setting , as long as patients are monitored.' [25] Due to the risk of aspiration pneumonia, GLP-1 RAs should be discontinued in patients severely ill with COVID-19 [26]. Cell studies have identified dipeptides peptidase-4 (DPP-4) as a functional receptor for human coronavirus-Erasmus Medical Center [27]. As such, inhibition of DPP-4 may be a potential mechanism by which severe symptoms of COVID-19 could be mitigated.

In Saudi Arabia, a study assessing the use of the Seha application that provides telemedicine services in the country, revealed that older adults, women, and people living in regions with inadequate internet services were less likely to use the application [28] Though most of our patients have not used telemedicine prior to this time, the extremely high use of smart devices and wide availability of access to the internet, including in remote areas in Saudi Arabia, made our transition to telemedicine a relatively smooth one.[29] Moreover, diabetes care is an area that is well suited to the use of telemedicine[30]

Studies of telemedicine in diabetes management have shown promising results [31]; as well as being used to provide care , telehealth visits can also be used to provide advice and education on exercise, diet, changes in therapy, and self-monitoring of blood glucose and blood pressure. Telemedicine has also been shown to be effective in helping lower HbA1c, as well as empowering patients [32,33]. A recent US claims database study has shown that there was a 100-fold increase in use of telehealth from 2019 (0.3%) to 2020 (29.1%), with the authors noting that this increased use did not negatively impact medication fills or glycemic control [34]. Exposure to COVID-19 can also be reduced by online prescription delivery systems, which have been shown to be successful in a number of studies from China [35].

Rationale:

The high prevalence of DM in the present study should be interpreted with caution, since the population is not homogenous, and a considerable number of non- Arabs, Indians in particular, who

have a different prevalence of DM than Arabs, were included in the analysis. This is important since diabetes and Covid-19 disproportionately affect racial. Emerging biomarkers in the context of DM and Covid-19 management which are not routinely assessed, the present study are robust, and adds value to the limited literature on Covid-19 patients within the Arab region, as it is the first to comprehensively describe the patients and differentiates characteristics based on sex, DM status, severity and outcome. However, much of the literature published focuses on the effects of COVID-19 in hospitalized patients, with few publications providing information and advice to those caring for people with diabetes in the primary care setting.

Aim of the study:

To assessment the importance of diabetes management during the COVID-19 pandemic in Makkah Al-Mukarramah Saudi Arabia .

Objectives:

To assessment the importance of diabetes management during the COVID-19 pandemic in Makkah Al-Mukarramah Saudi Arabia .

Methodology:

Study design:

This study is a cross sectional study

Study Area

Patients aged <35 to >65 years and above with type 2 DM during the COVID-19 Pandemic attending in primary health care outpatient in the diabetes center, the patients were recruited from an integrated care clinic at the diabetes center and clinics of the Family and Community Medicine Department at Makkah Al-Mokarrama, Saudi Arabia at diabetes center and clinics of the Family and Community Medicine Department, high-risk patients with type 2 diabetes during the COVID-19 Pandemic are referred to this diabetes center and clinics of the Family and Community Medicine Department from, the patients receive comprehensive diabetes care during the COVID-19 Pandemic

Study Population

The study has been conducted among patients aged 35 to >65 years and above with type 2 DM during the COVID-19 Pandemic attending in primary health care outpatient in the Diabetic Center, family and Community Medicine Department in the Makkah, from July and September 2022

Selection criteria:

Inclusion criteria

- In this study, the inclusion criteria included the following: patients aged 35 to >65 years with Type 2 Diabetes during the COVID-19 Pandemic .

Exclusion criteria :

- All patients with Type 1 Diabetes during the COVID-19 Pandemic and after receiving traditional care were excluded. Based on these inclusion and exclusion criteria, in the traditional care model, we included all the first 50 patients who met the criteria. Socio economic and clinical characteristics, such as age, sex, and comorbidities, were included in the Telemedicine. Hence, to include the children managed through Telemedicine. (200 patients).

Sample size

The sample size has been calculated by applying Raosoft sample size calculator based on (The margin of error: 5%, Confidence level: 95%, and the response distribution was considered to be 20%) accordingly the Sample size is 250 of diabetic patients attending and adding 10 more to decrease margin of error. After adding 5% oversampling, the minimum calculated sample has been (200). Computer generated simple random sampling technique was used to select the study participants.

Sampling technique :

Systematic random sampling technique is adopted. By using systematic sampling random as dividing the total population by the required sample size; (200)

Data collection tool

- Patients with Type 2 Diabetes during the COVID-19 Pandemic, Patients were followed for at least 3 month to assess the diabetes management during the COVID-19 pandemic

Diabetic patients' age, sex, disease duration, follow-up period, comorbidities, shipping, and the frequency of physical and Telemedicine. Visits were collected.

- Consequently, the costs, namely the costs of medications, laboratory tests, medical supplies, shipping, phone calls, and clinic visits were collected. The costs of visits to the clinic and laboratory tests were retrieved from the cost center of the Ministry of Health, Saudi Arabia.

Data collection technique :

Researcher has been visits the selected Diabetic Center after getting the approval from the ministry of health. She has been explained the purpose of the study to all participants attending the clinic. The data has been collect through the May and October 2022.

Data entry and analysis:

The Statistical Package for Social Sciences (SPSS) software version 24.0 has been used for data entry and analysis. Descriptive statistics (e.g., number, percentage) and analytic statistics using test for the association and the difference between two categorical variables were applied. A p-value ≤ 0.05 has been considered statistically significant.

Pilot study:

A pilot study has been conducted to test the methodology of the study, the questionnaire has been clear .

Ethical considerations:

- Permission has been obtained, and has been Verbal consents from all participants in the questionnaire were obtained.
- All information was kept confidential, and a result has been submitted to the department as feedback.

Budget: Self-funded

Results

Table 1 Distribution of demographic data characteristics of the patients diabetes management during the COVID-19 pandemic (age, gender, Level of education, Nationality, Marital status, economic level) in our study(n=200).

	N	%
Age		
<35	48	24
35-45	70	35
45-55	58	29
>65	24	12
Gender		

Female	94	47
Male	106	53
Level of education		
Primary	24	12
Intermediate	46	23
Secondary	56	28
High education	74	37
Nationality		
Saudi	150	75
Non-Saudi	50	25
Marital status		
Single	42	21
Married	96	48
Divorced	24	12
Widow	38	19
Smoking		
Smoker	78	39
Non-smoker	122	61
Economic level		
Low	84	42
Average	76	38
High	40	20

Table 1 shows that most of the participants (35.0%) were in the age group 35-45 years follow by the (29.0%) were the age group 45-55 years, the majority of them were male (53.0%) while female(47.0%), regarding Educational level the majority of participant are high education were(37.0%) while Secondary were(28.0%).also regarding Nationality the majority of participant are Saudi were(75.0%) while Non- Saudi

were(25.5%). Regarding the Marital status the majority of participant Married were (48.0%) while single were(21.0%). Regarding the Smoking the majority of participant Non-smoker were (61.0%) while smoker were(39.0%) .Regarding the Economic level the majority of participant low were (42.0%) while average were(38.0%) .

Table 2. Distribution of diabetes management during the COVID-19 pandemic characteristics of the patients

	N	%
Sources of information about diabetes management care		
Booklets and brochures	20	10
Mass media	26	13
Own personal experience	44	22
Educational films	10	5
Medical education in health centers and hospitals	98	49
The Comorbidities diabetes (%)		
Vitamin D deficiency	50	25
Obesity	86	43
Hypertension	130	65
Diabetes mellitus	138	69
Cardiovascular disease	24	12
Congestive heart failure	10	5
Chronic kidney disease	18	9
Stroke	6	3
Medications (%)		

β-Blockers	30	15
ACE inhibitors	44	22
ARB	70	35
CCB	36	18
Statins	22	11
GLP-1 agonists	26	13
Insulin	130	65
Oral hypoglycemic	52	26
Anti-coagulants	60	30
Anti-platelets	46	23
Levothyroxine	38	19
Number of comorbidities		
<2	50	25
2-4.	64	32
4-6.	86	43
Disease duration		
Less than 1 years	36	18
2-4 years	66	33
4-6years	64	32
More than 6 years	34	17
BMI		
Under weight	38	19
Normal	44	22
Overweight	118	59

Table (2) show the Sources of information about diabetes management care the majority of participant from Medical education in health centers and hospitals were(49.0%), while Own personal experience were (22.0%) , regarding the The Comorbidities of type 2 diabetes the majority of participant Diabetes mellitus were(69.0%), followed by Hypertension disease were (65.0%) while Obesity disease were (43.0%), regarding the Medications the majority of participant used Insulin were (65.0%)followed by ARB were

(35.0%), while Anti-coagulants were(30.0%), regarding the Number of comorbidities the majority of participant from 4-6.were (43.0%) followed by 2-4 were (32.0%) but <2 were (25.0%), regarding the disease duration most of participants more than 2-4 years were(33.0%) followed by 4-6 were (32.0%), regarding the BMI shown the majority of participant Overweight were (59.0%) followed by Normal were(22.0%) .

Table 3 Distribution the knowledge of the importance of diabetes management during the COVID-19 pandemic

Questions about importance of diabetes management during the COVID-19 pandemic	Know		middle		don't know		%	Chi-square	
	N	%	N	%	N	%		X ²	P-value
does it remain important to consider diabetes and COVID-19?	136	68	50	25	14	7	87.00	117.880	<0.001*
Do you know Why are people with diabetes at increased risk of poor outcomes with COVID-19?	70	35	36	18	94	47	62.67	25.480	<0.001*
Is there a difference in COVID-19 outcomes in people with type 1 versus type 2 diabetes	88	44	32	16	80	40	68.00	27.520	<0.001*
Is the relationship between diabetes and poor COVID-19 outcomes because of diabetes itself, degree of glucose control, or both	96	48	62	31	42	21	75.67	22.360	<0.001*
Do you know the effect of ACE inhibitor therapy on COVID-19 risk in people with diabetes	92	46	50	25	58	29	72.33	14.920	<0.001*

Do you know the importance of glycemic control in the COVID-19 era and the role of primary care	70	35	30	15	100	50	61.67	37.000	<0.001*
Do you know considerations for use of ant hyperglycemic agents in the COVID-19 era	56	28	32	16	112	56	57.33	50.560	<0.001*
Do you know approach telehealth for my patients with diabetes during the COVID-19 pandemic?	128	64	36	18	36	18	82.00	84.640	<0.001*
Do you know the correct timely and effective initiation of injectable therapy during the COVID-19 pandemic	64	32	44	22	92	46	62.00	17.440	<0.001*
people with diabetes maintain a good glucose control during the COVID-19 pandemic	120	60	40	20	40	20	80.00	64.000	<0.001*

Table (3) show that Questions about importance of diabetes management during the COVID-19 pandemic, regarding does it remain important to consider diabetes and COVID-19 the most of participant know were (68.0%) followed by middle were(25.0%)and a significant relation were P-value=0.001 X^2 117.880, and % were (87.00%), regarding do you know Why are people with diabetes at increased risk of poor outcomes with COVID-19 the most of participant don't know were (47.0%) and a significant relation were P-value=0.001 X^2 25.480, and % were (62.67%), regarding Is there a difference in COVID-19 outcomes in people with type 1 versus type 2 diabetes the most of participant know were (44.0%) and a significant relation were P-value=0.001 X^2 27.520, and % were (68.00%), regarding Is the relationship between diabetes and poor COVID-19 outcomes because of diabetes itself, degree of glucose control, or both the most of participant know were (48.0%) and a significant relation were P-value=0.001 X^2 22.360, and % were (75.67%),regarding Do you know the effect of ACE inhibitor therapy on COVID-19 risk in people with diabetes the most of participant know were (46.0%) and a significant relation were P-value=0.001 X^2 72.33, and % were (75.67%), regarding Do you know the importance of glycemic control in the COVID-19 era and the role of primary care the most of participant don't know were (50.0%) and a significant relation were P-value=0.001 X^2 37.000, and % were (61.67%), regarding Do you know considerations for use of ant hyperglycemic agents in the COVID-19 era the most of participant don't know were (56.0%) and a significant relation were P-value=0.001 X^2 50.560, and % were (57.33%), regarding Do you know approach telehealth for my patients with diabetes during the COVID-19 pandemic the most of participant know were (64.0%) and a significant relation were P-value=0.001 X^2 84.640, and % were (82.00%), regarding Do you know the correct timely and effective initiation of injectable therapy during the COVID-19 pandemic the most of participant don't know were (46.0%) and a

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Discussion

The current assessment surveyed a large number of participants, 200 participants to assessment the importance of diabetes management during the COVID-19 pandemic in Makkah Al-Mukarramah Saudi Arabia .

Although the of diabetes management during the COVID-19 pandemic attending primary healthcare centers very important but the prevalence of diabetes mellitus (DM) is high among populations in Makkah City, patients often lack the diabetes management during the COVID-19 pandemic [36]. There may be a gap between knowledge about the risk of Type 2 Diabetes among patients with Visiting the PHC, despite the high prevalence . Cross-sectional studies have suggested that the prevalence of T2DM in Saudi ranges from 10% to 30%[23].This is the first study to assessment the importance of diabetes management during the COVID-19 pandemic in Makkah Al-Mukarramah Saudi Arabia attending primary healthcare centers. Due to the increased risk of serious disease with COVID-19 in people with diabetes, it is important that patients are well informed on the importance of optimal metabolic and glycemic control. Fears relating to COVID-19 that may lead patients to avoid seeking medical advice should be proactively addressed, particularly for those with uncontrolled blood glucose, a risk factor for severe COVID-19 disease. Ant hyperglycemic therapy should be optimized to achieve HbA1c targets while exercising caution regarding premature discontinuation of established therapy [37]

In the present study, shows that most of the participants (35.0%) were in the age group 35-45 years, the majority of them were male (53.0%) Educational level the majority of participant are high education were(37.0%) also regarding

Nationality the majority of participant are Saudi were(75.0%), regarding the Marital status the majority of participant Married were (48.0%). Regarding the Smoking the majority of participants Non-smoker were (61.0%). Regarding the Economic level the majority of participant low were (42.0). (See table1)

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For those who need it, providing timely treatment intensification to injectable therapy during the COVID-19 pandemic may necessitate the use of telemedicine. It has already been shown that telehealth monitoring can improve support for people with T2D initiating insulin [58]; and in patients with T1D receiving insulin therapy with a subcutaneous pump, telehealth has been used to successfully lower HbA1C with no increase in

diabetic ketoacidosis events despite no in-office visits for 6 months [22]. The most important factor is to identify patients who need to start injectable therapy. It is vital that the limiting factor on moving forward with intensification is not that the consultation may have to be virtual.) (See Table 3).

Conclusions

The prevalence of DM is high among the primary care setting Covid-19 patients in Makkah. While DM patients have a higher mortality rate than their non-DM counterparts, other factors such as old age, congestive heart failure, smoking, β -blocker use, presence of bilateral lung infiltrates, elevated cretonne and severe vitamin D deficiency, appear to be more significant predictors of fatal outcome. Patients with acute metabolic dysfunctions, including hyperglycemia . This manuscript description the current knowledge of the risk and outcomes of individuals with diabetes who are infected with COVID-19 and provides information for PCPs on the importance of glucose control, appropriate treatment, and use of telemedicine and online prescription delivery systems to limit the potentially devastating effects of COVID-19 in people with hyperglycemia.

References:

1. Korytkowski, M., Antinori-Lent, K., Drincic, A., Hirsch, I. B., McDonnell, M. E., Rushakoff, R., & Muniyappa, R. (2020). A pragmatic approach to inpatient diabetes management during the COVID-19 pandemic. *The Journal of Clinical Endocrinology & Metabolism*, 105(9), 3076-3087.
2. Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet infectious diseases*, 20(5), 533-534.
3. Sheshah, E., Sabico, S., Albakr, R. M., Sultan, A. A., Alghamdi, K. S., Al Madani, K., ... & Al-Daghri, N. M. (2020). Prevalence of Diabetes, Management and Outcomes among Covid-19 Patients; HCQ protects from Covid-19 death by 88%: Saudi Arabia. *Prevalence*.
4. Barry, M., Al Amri, M., & Memish, Z. A. (2020). COVID-19 in the shadows of MERS-CoV in the Kingdom of Saudi Arabia. *Journal of epidemiology and global health*, 10(1), 1..
5. Terpos, E., Engelhardt, M., Cook, G., Gay, F., Mateos, M. V., Ntanasis-Stathopoulos, I., ... & Sonneveld, P. (2020). Management of patients with multiple myeloma in the era of COVID-19 pandemic: a consensus paper from the

- European Myeloma Network (EMN). *Leukemia*, 34(8), 2000-2011.
6. Chung, J. Y., Thone, M. N., & Kwon, Y. J. (2021). COVID-19 vaccines: The status and perspectives in delivery points of view. *Advanced drug delivery reviews*, 170, 1-25.
 7. Alkahtani, T. A., Alakeel, A., Alakeel, R. A., Khorshid, F. A., Alshammari, H. H., Alguwaihes, A. M., ... & Jammah, A. A. (2021). The current reproduction number of COVID-19 in Saudi Arabia: is the disease controlled?. *Environmental Science and Pollution Research*, 28(33), 44812-44817.
 8. Obied, D. A., Alhamlan, F. S., Al-Qahtani, A. A., & Al-Ahdal, M. N. (2020). Containment of COVID-19: the unprecedented response of Saudi Arabia. *The Journal of Infection in Developing Countries*, 14(07), 699-706.
 9. Almotawa, A. A. (2018). *Prevalence and Risk Factors of Diabetes and Insulin Resistance in Patients Attending a Health Care Centre in Kuwait, and the Accuracy of a Point of Care Device to Measure Glycated Haemoglobin to Monitor Patients with Diabetes*. The University of Liverpool (United Kingdom).
 10. Powell-Wiley, T. M., Poirier, P., Burke, L. E., Després, J. P., Gordon-Larsen, P., Lavie, C. J., ... & American Heart Association Council on Lifestyle and Cardiometabolic Health; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; Council on Epidemiology and Prevention; and Stroke Council. (2021). Obesity and cardiovascular disease: a scientific statement from the American Heart Association. *Circulation*, 143(21), e984-e1010.
 11. Banerjee, M., Chakraborty, S., & Pal, R. (2020). Diabetes self-management amid COVID-19 pandemic. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(4), 351-354.
 12. Zhang, J., Kong, W., Xia, P., Xu, Y., Li, L., Li, Q., ... & Zeng, T. (2020). Impaired fasting glucose and diabetes are related to higher risks of complications and mortality among patients with coronavirus disease 2019. *Frontiers in endocrinology*, 11, 525.
 13. Smith, S. M., Boppana, A., Traupman, J. A., Unson, E., Maddock, D. A., Chao, K., ... & Connor, R. I. (2021). Impaired glucose metabolism in patients with diabetes, prediabetes, and obesity is associated with severe COVID-19. *Journal of medical virology*, 93(1), 409-415.
 14. Singh, A. K., & Khunti, K. (2020). Assessment of risk, severity, mortality, glycemic control and antidiabetic agents in patients with diabetes and COVID-19: a narrative review. *Diabetes research and clinical practice*, 165, 108266.
 15. Janik, E., Niemcewicz, M., Podogrocki, M., Majsterek, I., & Bijak, M. (2021). The emerging concern and interest SARS-CoV-2 variants. *Pathogens*, 10(6), 633.
 16. Gidari, A., Sabbatini, S., Bastianelli, S., Pierucci, S., Busti, C., Monari, C., ... & Francisci, D. (2021). Cross-neutralization of SARS-CoV-2 B. 1.1. 7 and P. 1 variants in vaccinated, convalescent and P. 1 infected. *Journal of Infection*, 83(4), 467-472.
 17. Khan, A., Alahmari, A., Almuzaini, Y., Alturki, N., Aburas, A., Alamri, F. A., ... & Jokhdar, H. A. (2021). The role of digital technology in responding to COVID-19 pandemic: Saudi Arabia's experience. *Risk Management and Healthcare Policy*, 14, 3923.
 18. Barron, E., Bakhai, C., Kar, P., Weaver, A., Bradley, D., Ismail, H., ... & Valabhji, J. (2020). Associations of type 1 and type 2 diabetes with COVID-19-related mortality in England: a whole-population study. *The lancet Diabetes & endocrinology*, 8(10), 813-822.
 19. Khunti, K., Del Prato, S., Mathieu, C., Kahn, S. E., Gabbay, R. A., & Buse, J. B. (2021). COVID-19, hyperglycemia, and new-onset diabetes. *Diabetes Care*, 44(12), 2645-2655.
 20. Boye, K. S., Tokar Erdemir, E., Zimmerman, N., Reddy, A., Benneyworth, B. D., Dabora, M. C., ... & Etemad, L. (2021). Risk factors associated with COVID-19 hospitalization and mortality: a large claims-based analysis among people with type 2 diabetes mellitus in the United States. *Diabetes Therapy*, 12(8), 2223-2239.
 21. Shi, Q., Zhang, X., Jiang, F., Zhang, X., Hu, N., Bimu, C., ... & Wang, W. (2020). Clinical characteristics and risk factors for mortality of COVID-19 patients with diabetes in Wuhan, China: a two-center, retrospective study. *Diabetes care*, 43(7), 1382-1391.
 22. Nasser, A. A., Alzahrani, R. M., Fellah, C. A., Jreash, D. M., Almuwallad, N. T. A., Bakulka, D. S. A., & Abed, R. A. R. O. (2021). Measuring the patients' satisfaction about telemedicine used in Saudi Arabia during COVID-19 pandemic. *Cureus*, 13(2).

23. Bali, S. (2018). Barriers to development of telemedicine in developing countries. In *Telehealth*. IntechOpen.
24. Suleyman, G., Fadel, R. A., Malette, K. M., Hammond, C., Abdulla, H., Entz, A., ... & Brar, I. (2020). Clinical characteristics and morbidity associated with coronavirus disease 2019 in a series of patients in metropolitan Detroit. *JAMA network open*, 3(6), e2012270-e2012270.
25. Kosiborod, M. (2021). Dapagliflozin in respiratory failure in patients with COVID-19 (DARE-19). *Proceedings of the American College of Cardiology Virtual Annual Scientific Session (ACC 2021), Washington, DC, USA, 2-4*.
26. Apicella, M., Campopiano, M. C., Mantuano, M., Mazoni, L., Coppelli, A., & Del Prato, S. (2020). COVID-19 in people with diabetes: understanding the reasons for worse outcomes (vol 8, pg 782, 2020). *Lancet Diabetes & Endocrinology*, E5-E5.
27. Raj, V. S., Mou, H., Smits, S. L., Dekkers, D. H., Müller, M. A., Dijkman, R., ... & Haagmans, B. L. (2013). Dipeptidyl peptidase 4 is a functional receptor for the emerging human coronavirus-EMC. *Nature*, 495(7440), 251-254.
28. Alharbi, A., Alzuwaed, J., & Qasem, H. (2021). Evaluation of e-health (Seha) application: a cross-sectional study in Saudi Arabia. *BMC medical informatics and decision making*, 21(1), 1-9.
29. Altulaihi, B. A., Alharbi, K. G., Alhassan, A. M., Altamimi, A. M., & Al Akeel, M. A. (2021). Physician's perception toward using telemedicine during COVID-19 pandemic in King Abdulaziz Medical City, Riyadh, Saudi Arabia. *Cureus*, 13(7).
30. Association, A. D. (2020). 1. Improving care and promoting health in populations: Standards of Medical Care in Diabetes—2020. *Diabetes care*, 43(Supplement_1), S7-S13.
31. Solerte, S. B., D'Addio, F., Trevisan, R., Lovati, E., Rossi, A., Pastore, I., ... & Fiorina, P. (2020). Sitagliptin treatment at the time of hospitalization was associated with reduced mortality in patients with type 2 diabetes and COVID-19: a multicenter, case-control, retrospective, observational study. *Diabetes care*, 43(12), 2999-3006.
32. McGloin, H., O'Connell, D., Glacken, M., McSharry, P., Healy, D., Winters-O'Donnell, L., ... & Doherty, L. (2020). Patient empowerment using electronic telemonitoring with telephone support in the transition to insulin therapy in adults with type 2 diabetes: observational, pre-post, mixed methods study. *Journal of medical Internet research*, 22(5), e16161.
33. De Groot, J., Wu, D., Flynn, D., Robertson, D., Grant, G., & Sun, J. (2021). Efficacy of telemedicine on glycaemic control in patients with type 2 diabetes: a meta-analysis. *World journal of diabetes*, 12(2), 170.
34. Patel, S. Y., McCoy, R. G., Barnett, M. L., Shah, N. D., & Mehrotra, A. (2021). Diabetes care and glycemic control during the COVID-19 pandemic in the United States. *JAMA internal medicine*, 181(10), 1412-1414.
35. Liu, L., Gu, J., Shao, F., Liang, X., Yue, L., Cheng, Q., & Zhang, L. (2020). Application and preliminary outcomes of remote diagnosis and treatment during the COVID-19 outbreak: retrospective cohort study. *JMIR mHealth and uHealth*, 8(7), e19417.
36. Nachimuthu, S., Vijayalakshmi, R., Sudha, M., & Viswanathan, V. (2020). Coping with diabetes during the COVID-19 lockdown in India: Results of an online pilot survey. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(4), 579-582.
37. Ding, L., She, Q., Chen, F., Chen, Z., Jiang, M., Huang, H., ... & Liao, C. (2020). The internet hospital plus drug delivery platform for health management during the COVID-19 pandemic: observational study. *Journal of Medical Internet Research*, 22(8), e19678.