



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Diabetes management and specific considerations for patients with diabetes during coronavirus diseases pandemic: A scoping review

Anggi Lukman Wicaksana^{a, b, *}, Nuzul Sri Hertanti^c, Astri Ferdiana^{c, d}, Raden Bowo Pramono^{e, f}^a Department of Medical Surgical Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia^b The Sleman Health and Demographic Surveillance System (HDSS), Universitas Gadjah Mada, Yogyakarta, Indonesia^c Center for Tropical Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia^d Faculty of Medicine, University of Mataram, West Nusa Tenggara, Indonesia^e Department of Internal Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia^f Dr. Sardjito General Hospital, Yogyakarta, Indonesia

ARTICLE INFO

Article history:

Received 21 May 2020

Received in revised form

27 June 2020

Accepted 30 June 2020

Keywords:

COVID-19

Diabetes

Diabetes management

Pandemic

Scoping review

Special consideration

ABSTRACT

Background and aims: The global pandemic of coronavirus (COVID-19) affects almost all countries in the world, which potentially alter diabetes management. Many diabetes patients are experiencing barrier of care due to the policy related to COVID-19. This article aims to review the current evidence on diabetes management and specific considerations during the COVID-19 pandemic for people living with diabetes. **Methods:** We conducted a scoping review in PubMed, Science Direct, DOAJ and Microsoft Academics databases from January 1 to April 17, 2020. Searching terms included “COVID-19”, “severe acute respiratory syndrome coronavirus 2”, and “Diabetes Mellitus” were used. Only scientific articles discussing diabetes management and specific considerations were selected and extracted.

Results: A total of 7 articles was selected in the analysis. Most were published in diabetes journals (85.71%). All articles (100%) discussed diabetes management and 71.43% of them provided diabetes care in specific considerations. We discussed issue of diabetes management in glycemic control and monitoring, dietary intake, physical activity, medication, education and prevention of COVID-19 infection that applicable for diabetes patients. In addition, specific considerations explored caring for diabetes in children and adolescents, pregnancy, elderly, emergency or critical care, to offer certain concern for raising the awareness.

Conclusions: This review specifies a summary of diabetes management as well as the particular considerations to care people living with diabetes during COVID-19 pandemic. Patients, health care providers, and policy makers could take advantage of the review to assist diabetic people passing through COVID-19 pandemic session with optimum glycemic outcome.

© 2020 Diabetes India. Published by Elsevier Ltd. All rights reserved.

1. Background

The rapid spreading of COVID-19 globally has extensively brought many consequences on care particularly for patients who have comorbid conditions [1,2]. Diabetes ranked second as the most prevalent comorbidities (9.7%, 95% CI 6.9–12.5%) among COVID-19 patients after cardio-metabolic diseases [1,3,4]. People living with diabetes are at higher risk of having COVID-19 infection and potentially experiencing more severe illness when infected

[4,5]. A meta-analysis from China reported that COVID-19 patients with diabetes had twice the risk of intensive care unit (ICU) admission [6] and it makes diabetes as independent predictor of ICU admission or invasive mechanical ventilation in COVID-19 patients [3,7]. A recent systematic review also identified that COVID-19 patients with diabetes is related to an increased risk of ICU admission (OR: 2.79, 95% CI 1.85–4.22, $I^2 = 46%$, $p < 0.0001$) and higher mortality rate (OR 3.21, 95% CI 1.82–5.64, $I^2 = 16%$, $p < 0.0001$) [3].

Maintaining good glycemic control is an effective approach to prevent COVID-19 transmission in diabetic patients [7,8]. However, in many countries, diabetes control becomes challenging because of the imposing government policy to control transmission such as social distancing and lockdown. Most diabetic people could

* Corresponding author. Department of Medical Surgical Nursing & The Sleman Health and Demographic Surveillance System (HDSS), Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Ismangoen Bd 2F Jl. Farmako, Sekip Utara, Yogyakarta, Indonesia.

E-mail address: anggi.l.wicaksana@ugm.ac.id (A.L. Wicaksana).

experience barriers in accessing measures for controlling their glycemic level such as limited access to healthcare, limited availability of fresh food, and limited physical activity because of confinement [7]. The COVID-19 during pandemic affects diabetes management. Diabetes educators, physicians, nurses and other health care providers, need appropriate and accurate information to facilitate diabetic patients in taking care of their diabetes amid the COVID-19 pandemic. Therefore, the aim of this paper is to provide a review on the appropriate diabetes management during the COVID-19 pandemic for people living with diabetes. In addition, this review will identify particular care of diabetes in specific conditions.

2. Methods

2.1. Study design

Scoping review aims to draw key concepts of available literature in underpinning a research area. This design was chosen because it provided a broaden scope of specific field. The scoping review procedure proposed by Arksey & O'Malley was used [9]. This procedure suggests five steps for a rigorous review; 1) identifying clear research aims and searching strategies, 2) identifying appropriate research papers, 3) selecting research paper, 4) extracting and charting the data, 5) summarizing, analyzing and presenting the outcomes on report.

2.2. Literature search strategy

Literature search was conducted extensively by searching in several databases. Two authors (ALW and NSH) performed independently search on PubMed, Science Direct, Directory of Open Access Journal (DOAJ), and Microsoft Academics databases for literatures published between January 1 and April 17, 2020. The keywords were adopted from Medical Subheading (MESH) and used Boolean to improve sensitivity. The following search terms adopted from MESH were used: (“COVID-19” OR “severe acute respiratory syndrome coronavirus 2”) AND “Diabetes Mellitus”. Only English literatures were included for review. Non-scientific publication, correspondences, news and commentary were excluded.

2.3. Identification and selection relevant articles

The outcome of two independent searches was compared. Difference finding were communicated and discussed until the same numbers of articles were reported. Duplicated articles were removed. Excel spreadsheet was used to short-list the articles during selection procedure. Seven articles were included for review after screening and checking eligibility. The preferred reporting item for systematic review and meta-analysis (PRISMA) was used as guidance in reporting the searching process (Fig. 1) [10].

2.4. Data extraction

Included articles were compiled and extracted in an Excel worksheet. The extracted data included title, authors and date of publication, country and region, research objective, study design, target of study, sample size, study setting, data collection, key findings, research domains and subdomains.

2.5. Summarizing the findings

All the included articles were categorized into two domains i.e. diabetes management and specific consideration. Diabetes

management refers to all actions to treat, manage and cope with disease process of diabetes. Specific consideration concerns on such particular situation that requires thoughtfulness of care. Diabetes management domain was further classified into six sub-domains i.e. glycemic control and monitoring, dietary intake, physical activity, medication, education, and prevention. Specific consideration was classified into sub-domains of diabetes in children and adolescents, pregnancy, older people, and emergency or critical care.

Methodological characteristics of the articles were also evaluated using Excel spreadsheet. Each article will be assessed about the study design, target of study, sample size, and setting. Then, the data were classified and presented in the percentage.

3. Results

3.1. Characteristic of published articles

Most articles were published in journal of diabetes and metabolic diseases (85.71%, $n = 6$) followed by medical virology journal (14.29%, $n = 1$). The majority of articles were from Asian region (57.14%, $n = 4$) followed by European and American region (28.57%, $n = 2$; 14.29%, $n = 1$, respectively). All articles discussed diabetes management domain and only 71.43% provided information for specific consideration domain. Fig. 2 shows the subdomains identified in the articles. Most articles focused on medication (71.43%) and only 1 article (14.29%) discussed about COVID-19 preventive action for diabetes patients. In terms of specific consideration domain, most articles focused on emergency or critical care (42.86%).

Most articles used review or unclear study design (42.86%, $n = 3$ for both). The majority of study targets were patients (57.14%, $n = 4$) and located in hospital and community setting (57.14%, $n = 4$). Most included studies did not reported sample size (71.43%, $n = 5$, Table 1).

3.2. Data extraction of the included articles

Information of data extraction is available in Table 2. All included articles covered research domains and subdomains through presenting main findings. Although some included articles did not provide detail information of study design, sample size, and data collection; the articles were analyzed and presented since it covered the research aims.

4. Discussion

4.1. Diabetes management

According to The American Diabetes Association standard of diabetes care for patients and health care workers, diabetes care should includes comprehensive medical assessment of comorbidities, lifestyle management, glycemic control, medication, obesity management, risk reduction, and prevention of diabetes complication [14–16]. Diabetes management will be discussed according to these standards of care; glycemic control and monitoring, dietary intake, physical activity, medication, education, and prevention of COVID-19 infection in the context of COVID-19 pandemic.

4.1.1. Glycemic control and monitoring

All diabetic patients must maintain glycemic control and monitoring during the pandemic. Patients with diabetes could potentially find difficulties for glycemic control and monitoring during the lockdown or quarantine. They could have problem on getting an access to medicine and glycemic monitoring materials,

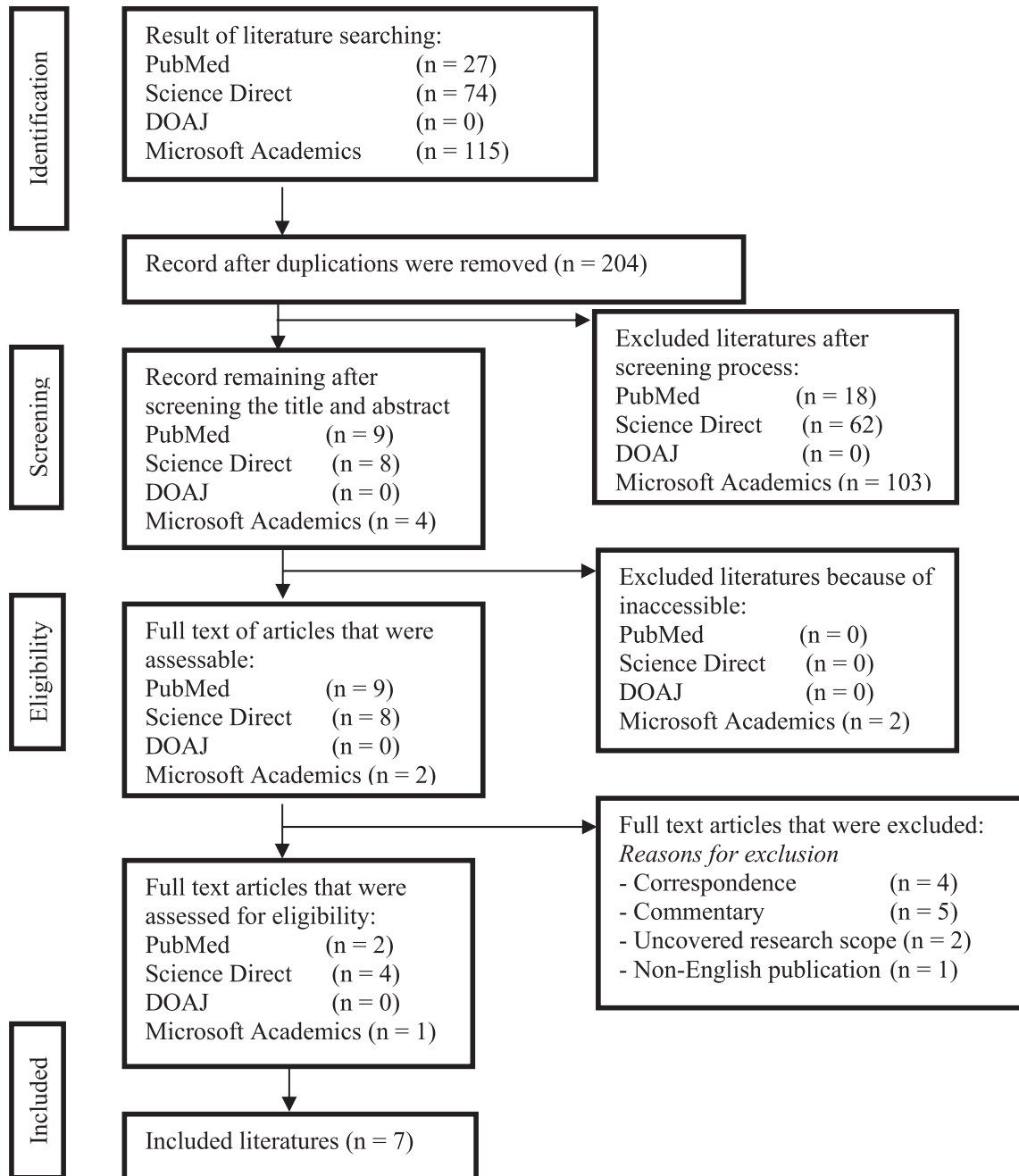


Fig. 1. PRISMA flow chart for scoping review.

including glucose strips, glucometers, and needles. Thus, it is recommended for diabetic patients to early purchase the glycemic monitoring materials and medicine through online [2,7,8]. A tailored glycemic monitoring for diabetic patients could be adjusted by considering age, existing comorbidity, clinical manifestation, and other risk factors [8]. Glycemic monitoring using capillary blood test is acceptable for people living with diabetes during pandemic [2,7].

All hospitalized COVID-19 patients with diabetes should undergo closed glycemic control and routine blood glucose monitoring. Previous research indicated that COVID-19 patients with diabetes were associated with the poor outcomes of health [3,7]. When they are discharged, blood glucose monitoring is highly recommended amid a 4-week follow up after discharge and they have to avoid exposure to infection [8].

Timing for glycemic control and monitoring can be adjusted for particular occasion. During pandemic, fasting and postprandial blood glucose in diabetes patients who consume oral anti diabetic agent(s) with tolerable outcomes (i.e. stable blood glucose record or fasting blood glucose less than 125 mg/dl or HbA1c less than or equal to 6.5%) could be performed once or twice a week. Meanwhile, for diabetes patients who administer insulin with poor outcomes or intermittent hypoglycemia, blood glucose should be checked at least four times a day i.e. fasting, pre lunch, pre dinner and bedtime. Any sign or symptom of occurring hypoglycemia is reason to immediately check capillary blood glucose. All blood glucose checking should be recorded for a minimum of consecutive three days and communicated to health care providers through tele-consultation [2,7].

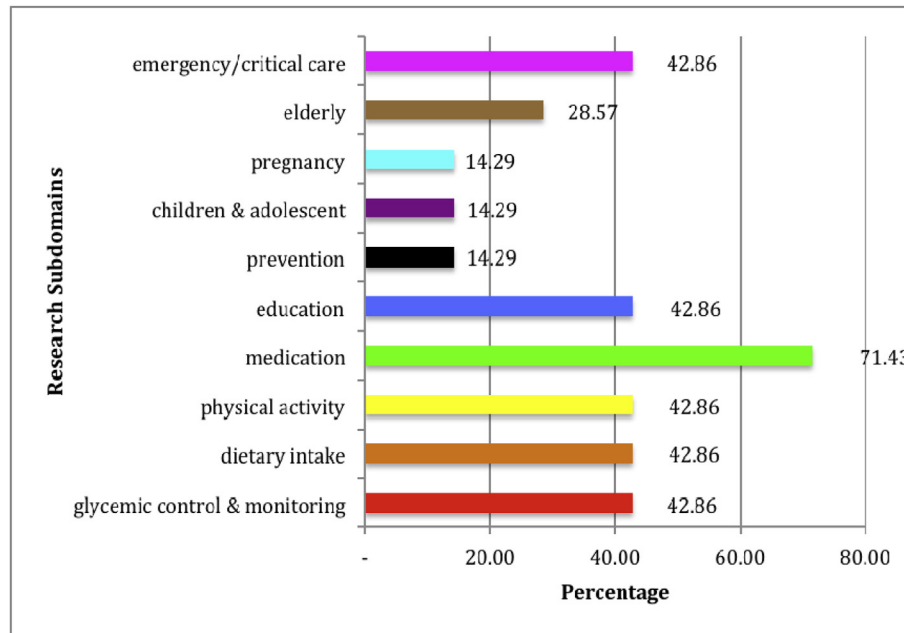


Fig. 2. Research subdomains of the published articles. Note: Percentage in this figure was not summed up to 100% due to possibility of multiple subdomains in one article.

Table 1
Methodological characteristic of the included articles (n = 7).

Characteristics	Categories	n	%
Study design	Review	3	42.86
	Case report	1	14.29
	Unavailable information	3	42.86
Target of study	Hospitalized patients	3	42.86
	Patients	4	57.14
Sample size	1	1	14.29
	Big size (31.624 patients)	1	14.29
	Unavailable information	5	71.43
Setting	Hospital	3	42.86
	Hospital and community	4	57.14

%-Relative frequency; n-number of article(s).

4.1.2. Dietary intake

Lockdown during COVID-19 pandemic could affect patient's dietary habit. Patients with diabetes may find limited access to fresh fruits and vegetables [2,7] and consume canned or packaged foods that are high in calories and/or fats [2]. Healthy and balanced diet should be emphasized and encouraged by dietician to diabetic patients during the consultation [7,13].

The recommended calorie intakes for obese and non-obese diabetes patients are 20 kcal/kg and 22–25 kcal/kg of ideal body weights with sedentary lifestyle, respectively. Dietary advice should include low carbohydrate intake, low fats intake, and optimal protein intake with no meal skipping [13]. Daily diet should be divided into three meals and a snack.

Variation of food composition is recommended, consisting of 50–60% complex carbohydrates, 25–45% fibers, up to 30% fats, 1 g/kg/day (general patients) or 0.8 g/kg/day (nephropathy and macroalbuminuria) of proteins. The use of oils should be no more than 3 teaspoons a day and less than 5 g/day for sodium intake. Patients could also use the diabetes plate method i.e. half plate of vegetables, one-fourth of proteins, and one-fourth of complex carbohydrates. Alcohol, smoking, and sugary sweetened foods should be avoided [7].

4.1.3. Physical activity

Social distancing, lockdown and home confinement require patients with diabetes to limit their activities or regular exercise.

However, they could still have limited access to indoor and outdoor physical activities [2]. Home exercise such as treadmill, stationary cycling or jogging and resistance training should be recommended [2,7,13].

Tailored physical activity while quarantine should be practiced about 60 min/day. The intensity and type of activities could be adjusted regarding individual patient's condition. The recommended physical activity is classified into three exercises i.e. aerobics, flexibility workout, and strength muscle exercises. Aerobic exercise with moderate intensity i.e. brisk walking, treadmill, stationary jogging or cycling, dancing, jumping, sport aerobic, and gardening, is suggested for a minimum of 30 min/day [7,13]. If this is unachievable, patients could take two or three times in small portion of aerobic exercise (10–15 min). Climbing stairs, household routine activities [7] or yoga practice as stretching technique [13] for 15 min/day is recommended as flexibility training [7,13]. A 11 steps of yoga pranayama for chronic condition could be implemented to enhance pulmonary function [17]. A 15 min of squats, push-ups, sit-ups, forward flexes or small weight lift as muscle training exercise every day is recommended as muscle training exercises [7,13]. A physical activity for diabetes patients with heart diseases or hypoglycemia history should be noticed as particular circumstance [7].

4.1.4. Medication

Health care providers need to assess patient's adherence to medication through tele-consultation using valid but brief tools. They also should make sure that all diabetes patients have sufficient medication stocks and prescribe enough medication because of limited access to clinic during the pandemic [7].

To date, there is no robust evidence of anti diabetic agents in the context of treatment for COVID-19 patients with diabetes though some anti diabetic agents indicate positive outcome of glycemic control. The application of angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARB) is hypothetically useful to treat COVID-19 patients, however, there is still no data to support it. Currently, the Association of European and American Cardiology and Hypertension recommend ACE inhibitors and ARB to treat COVID-19 although it lacks of evidence to support [2].

Table 2

Data extraction of the included articles (n = 7).

Author(s) & date of publication	Country/Region	Aim	Data collection	Key findings	Research domain/subdomain
Wang, Zhao, Xu & Gu, 13 March 2020 ⁸	China, Asia	To describe the urgency of blood glucose management during outbreak COVID-19 among diabetic patients	Unavailable information	<ol style="list-style-type: none"> 1. COVID-19 patients with diabetes had higher risk to develop septic shock and acute respiratory distress syndrome that make them easy to admit ICU (22.2%) or death (up to 7.3%). It is caused by stress condition and the increase of hyperglycemic hormones secretion, which results in abnormal variability of blood glucose, raised blood pressure, and complication. Tailored diabetes care and glycemic control are needed and adjusted regarding age, existing comorbidities, clinical manifestation and other risk factors. All hospitalized COVID-19 patients with diabetes are recommended to control blood glucose. When patients are discharged, a 4-week follow up of blood glucose homeostatic is monitored and they need to avoid infection. 2. Online education for diabetes patients was recommended and widely implemented through nation. Endocrinologists provided consultation via online and optimized WeChat application by sharing free educational e-books and videos for diabetes management and COVID-19 prevention. 3. Hospitalized COVID-19 patients with diabetes who receive critical care should be closed monitoring for blood glucose. Early identification and gradual reduction of adverse drug effect are crucial to minimize the worsen manifestation. 	1. Diabetes management: glycemic control and monitoring, education 2. Specific consideration: emergency or critical care
Brufsky, 15 April 2020 ¹¹	US, America	To provide theoretical framework of hydroxychloroquine benefits to control viral load while COVID-19 infection	Unavailable information	<ol style="list-style-type: none"> 1. High fasting blood glucose was identified as independent predictor of SARS mortality. Present diabetes was correlated with ICU admission (22.5%–58%) and contributed for mortality (7.6%) among COVID-19 patients. 2. Glucocorticoid therapy was delivered for 44.9% non-ICU and 72.2% ICU patients with COVID-19 and it was associated with hyperglycemia and induced more severe clinical manifestation. Current review suggested the use of glucocorticoid in viral diseases was not recommended for COVID-19 pneumonia and it caused harm. 3. In the small-randomized trial, 62 COVID-19 patients with mild sign and symptoms of COVID-19 pneumonia (by CT scan), randomly received oral hydroxychloroquine 200 mg twice/day for 5 days. The 80.6% of patients improved their COVID-19 pneumonia findings (p = 0.047) and none of them developed severe COVID-19 pneumonia. 4. Among COVID-19 patients with diabetes, hydroxychloroquine works as oral hypoglycemic agent to reduce glyated hemoglobin and finally hyperglycemia. 	1. Diabetes management: medication

Unavailable information

(continued on next page)

Table 2 (continued)

Author(s) & date of publication	Country/Region	Aim	Data collection	Key findings	Research domain/subdomain
Puig-Domingo, Marazuela, Giustina, 11 April 2, 020 ⁵	Spain, Europe	To provide endocrinologist statement in response with diabetes care during COVID-19 pandemic		<ol style="list-style-type: none"> 1. People with diabetes are recommended to do physical distancing and stay at home as primary prevention strategies. All diabetic patients should adhere and be strict to avoid the infection during pandemic session. They should make a future plan about what to do while confinement and getting sick. Maintaining good glycemic control is important to reduce risk of infection and/or the severity of infectious diseases. Type 1-diabetes patients should contact endocrinologists while type 2 diabetes patients need to consult with internal medicine specialists or general practitioners. It, however, is not recommended to do regular appointment. It is recommended to consult through emails, phone calls or video calls. Patients need to supply blood glucose sticks as well as glucometer and make sure for adequate medication. 2. When diabetes patients are suspected due to having fever and cough or dyspnea/pneumonia or have a history of visit pandemic regions or contact with confirmed COVID-19 patient, they should seek physicians' or nurses' advice and follow the medical protocol. When patients are suggested to go to hospital, make sure they use facemask. Samples from nose or throat will be examined as diagnosis procedure. 3. In case of home confinement, patients and families should follow the rules for affected or suspected person to prevent further transmission and closed monitor of clinical manifestation. The suspected people should stay in single room with proper ventilation while others live in different room. If it is inapplicable, at least keep 1-m distance with the suspected person and do routine hand washing after any contact with or the surroundings. It is recommended to use paper towel after hand washing or clean towel but replace it when getting wet. The affected person should put medical mask to cover nose and mouth. All caregivers also need to wear full-covered medical mask when in the same room with the suspected person. 	1 Diabetes management: prevention
Banerjee, Chakraborty & Pal, 13 April 2, 020 ⁷	India, Asia	To review any aspects of diabetes self management education as patient center care	Authors used three databases (PubMed, Embase and Google Scholar) till March 29. The keywords were "COVID-19", "diabetes self-care", "diabetes self-management education", "DSME", "diabetes self-management in India", "diabetes self-care in India" and "DSME in India"	<ol style="list-style-type: none"> 1. Policy of social distancing, isolation and lockdown affects diabetes care. Confinement may limit physical activities and limited stock of foods during lockdown could alter their dietary habits. Difficulty or limited procurement of medications and glucose strips may happen and they would not be able to do routine hospital visit. 	1. Diabetes management: education, dietary intake, physical activity, medication, glycemic control and monitoring.

Table 2 (continued)

Author(s) & date of publication	Country/ Aim Region	Data collection	Key findings	Research domain/subdomain
			<p>2. Since regular visit is not recommended, it is suggested to utilize tele-consultation by smart-phones to keep in touch with healthcare providers.</p> <p>3. Required calorie of daily intake for non-obese and obese patients is 22–25 kcal/kg and 20-kcal/kg of ideal body weights on sedentary lifestyle, respectively which distributed in three meals and a snack as their habits. Food composition should be maintained 50–60% (complex) carbohydrates, 25–45% fibers, no more than 30% fats, and 1 g/kg/day (general) or 0.8/kg/day (nephropathy and macro-albuminuria) for protein. Three teaspoons of oil/day (combined with 2 or more vegetable oils) and no more than 5 g of sodium in daily. Diabetes plate is recommended; half of plate is vegetable, one quarter of plate is proteins and the rest is complex carbohydrates. Sugar sweetened foods, smoking and drinking should be strictly avoided. Patients are recommended to do tele-consultation with nutritionist.</p> <p>4. Physical activities are suggested among diabetes patients in amount of 60 min/day, divided for aerobic, work-related and muscle-training activities. Moderate intensity of aerobic exercise for minimal 30-min/day e.g. brisk walking, treadmills, stationary cycling or jogging and gardening. If it is not achievable, patients should take two or three times in small portion 10–15 min. Climbing stairs and household chores for 15 min/day is suggested as work-related activities. A 15 min/day for muscle training exercise e.g. squats, push-ups, sit-ups, and forward flexes and resistance exercise (light weight), is recommended. Tailored exercise for intensity and type of activities should be addressed to individual patient and specific consideration should be noticed for patients with heart diseases and hypoglycemia history.</p> <p>5. Physicians and diabetes educators could monitor the adherence of medication through tele-consultation. The health care workers need to make sure patient's compliance and could use online check of drugs to ensure they get adequate medication stocks. In addition, patients should be educated about contraindication of hydroxychloroquine, i.e. diabetic retinopathy and history of seizure, to avoid adverse effect of the treatment.</p> <p>6. Self-monitoring of blood glucose using capillary blood is suitable. Patients may find difficulty to get the strips amid COVID-19, then, taking online store of pharmacy and prior order before the strips are used, are recommended. Patients who</p>	2. Specific elderly consideration:

(continued on next page)

Table 2 (continued)

Author(s) & date of publication	Country/ Region	Aim	Data collection	Key findings	Research domain/subdomain
Singh, Gupta, Ghosh, Misra, 9 April 2, 020 ²	India, Asia	To compile available evidences of prevalence, pathophysiology, prognosis and practical concerns among COVID-19 patients with diabetes	Two databases (PubMed and Google Scholar) were used with keywords 'COVID-19', 'SARS-CoV-2', 'diabetes', 'antidiabetic therapy' until April 2. Only full text articles were included.	<p>consume oral anti diabetes with acceptable outcomes, could test once to twice a week to monitor fasting and post prandial blood glucose. For those who administer insulin with recurrent hypoglycemia or poor glycemic control, should test minimum 4 times (fasting, pre-lunch, pre-dinner, and bedtime) a day. Any occasion when sign/symptom of hypoglycemia occurs, the prick test in capillary blood glucose should be conducted. All the monitoring should be recorded for at least 3 days and reported to health care workers while tele-consultation.</p> <p>7. Elderly patients living with type 2 diabetes were experiencing high blood glucose that indicated poor glycemic control while pandemic COVID-19.</p> <p>1. There is not clear data of oral anti diabetic agents to treat COVID-19 infection. Although some oral agents of anti diabetic seem indicating positive outcome, there is no confirmed report about the role of anti diabetic agents in the context of COVID-19 treatment. Currently the application of ACE inhibitors and ARB is theoretically useful, however, to date there is no robust evidence to support. Although there was a lack of evidence about the effectiveness of ACE inhibitors and ARB for COVID-19 patients, European and American cardiology and Hypertension Association recommended it to treat COVID-19 patients.</p> <p>2. Patients could perform self-checking and monitoring their blood glucose and the results should be communicated via phone to health care providers. Continues glucose monitoring potentially helps when the blood glucose records are accessible without visiting patients in remote areas. Patients may face difficulty in procuring strips, glucose-meters, needles and medicines.</p> <p>3. The pandemic situation leads many regions conduct lockdown, which results home confinement. Patients with diabetes may have limited opportunity to do exercise e.g. regular walks, swimming or visiting gyms. Home exercise should be conducted e.g. treadmill, cycling, stationary jogging and resistance exercise.</p> <p>4. Other impacts of lockdown make patients consume canned or packaged foods, which contain high calorie and/or fats. Limited access for fresh vegetables and fruits also can impact the patients during the pandemic COVID-19. Healthy and balanced diet should be always educated while consultation.</p> <p>5. The elderly patients who are living alone may face more complicated problems as results of lockdowns.</p> <p>6. Patients should notice an emergency situation that may happen such as</p>	<p>1. Diabetes management: medication, glycemic control and monitoring, physical activity, dietary intake.</p> <p>2. Specific consideration: elderly, emergency</p>

Table 2 (continued)

Author(s) & date of publication	Country/Region	Aim	Data collection	Key findings	Research domain/subdomain
Baretic, 13 April 2,020 ¹²	Croatia, Europe	To illustrate care experience in type 1 diabetes patient undergoing Chloroquine therapy	Author reported the progress and treatment for COVID-19 patients with type 1 diabetes	<p>drowsiness, vomiting, chest pain, short of breath, weakness of limb and altered sensorium. The entire situation should require hospital visit or admission.</p> <ol style="list-style-type: none"> 1. COVID-19 patient with type 1 diabetes who received Chloroquine therapy is potentially experiencing hypoglycemia as its side effect. Chloroquine agent has hypoglycemia and immunomodulatory effects; therefore, all type 1-diabetes patients who are undergoing Chloroquine therapy should be intensively monitored for their blood glucose. 2. Chloroquine alone leads the increase of serum insulin level in diabetic animals through providing a signal to cellular receptors and post-receptor clearance. Lysosomotropic and immunomodulatory process are potentially associated with anti-inflammatory effect of Chloroquine. Thus, close monitoring is inevitable among type 1 diabetes patients treating with Chloroquine and it may require adjustment of insulin dose when needed. 	1. Diabetes management: medication.
Ghosh, Gupta, Misra, 4 April 2,020 ¹³	India, Asia	To identify the feasibility of telemedicine practice for patients living with diabetes amid the COVID-19 pandemic	The keywords of 'telemedicine', 'diabetes', 'COVID-19' were implemented in two databases, PubMed and Google Scholar till March 2020. Authors also searched the available guideline	<ol style="list-style-type: none"> 1. Meta-analysis of RCT telemedicine through email, phone or video in China for 3–60 months, indicated significant reduction of HbA1c $-0.37%$ ($p < 0.001$). Further review in Cochrane found similar pattern in which HbA1c reduction of $-0.31%$ ($p < 0.001$). Current review of telemedicine among type 1 ($n = 2052$) and type 2 diabetes ($n = 24,000$) also indicated significantly reduction of HbA1c ($-0.12%$ to $-0.86%$ and $-0.01%$ to $-1.13%$, respectively). 2. The recommended telemedicine is video mode approach for first consult. Keep maintain patient's privacy, confidentiality and consent from patients or surrogates or caregivers are crucial points. Medical records should be completed with radiology and laboratory findings and prescription. In case of impossible application of telemedicine, consultation could be done in face-to-face but it should consider appropriate place and time to prevent transmission. Telemedicine is not appropriate to prescribe any psychotropic or narcotic agents. History of previous complaints, allergy, and medical records (including hypoglycemia) should be obtained. On the other hand, clinical examination is not able to perform. Video or photograph could help when finding any lesion on foot, abscess or other visible wounds. Any noticeable neurological deficit could be identified through consultation or ask patients to perform several simple and independent neurological assessment. When, it is no doable, patients should visit clinic for comprehensive 	1. Diabetes management: education, dietary intake, physical activity, and medication. 2. Specific consideration: pregnancy, children and adolescent, emergency or critical care

(continued on next page)

Table 2 (continued)

Author(s) & date of publication	Country/ Region	Aim	Data collection	Key findings	Research domain/subdomain
				<p>assessment. All patients should understand the sign/symptom and treatment for hypoglycemia. Precautions of COVID-19 such as hand washing, cough hygiene and social distancing are compulsory.</p> <ol style="list-style-type: none"> All patients should receive advice for bedtime snacks, low carbohydrate and fats intake, and optimal protein intake. Skipping meals are not recommended. Advice for active physical activity should be delivered while staying at home. The exercise could consist of stretching (e.g. yoga), muscle strengthening (e.g. small weight lift), and aerobic exercise (e.g. dancing, cycling, jumping, treadmill or sport aerobics). Adjustment of sulfonylureas or insulin dose may be required to avoid hypoglycemia but major changes are not recommended. All patients should receive adverse effect education of anti diabetic agents and actively report any problems related to side effects. Gestational diabetes for first time education should administer insulin initiation and receive specific diabetes education program for lifestyle management. In case of follow up patients, minor dose adjustment may be required and all consultation could be conducted through telemedicine. Type 1-diabetes patients should be advised to check ketones when hyperglycemia symptoms occur. For all new diagnosis type 1-diabetes should undergo face-to-face consultation with educational highlight on insulin administer, hypoglycemia and ketoacidosis information as well as the management for patients and families. Diabetes patients with foot lesion/ infection/gangrene, severe hypoglycemia, gastroenteritis, any other infections related to COVID-19 or acute deterioration of organ functions should be considered as special situation that need face-to-face consultation and hospitalization. 	

Adjustment of sulfonylurea and insulin dose may be necessary to prevent hypoglycemia. All diabetes patients should be provided information on adverse effects of anti-diabetic agents and encourage them to report any adverse effect [13]. Additionally, it was reported that 44.9% non-ICU and 72.2% ICU patients with COVID-19 received glucocorticoid therapy as daily treatment. Glucocorticoid was associated with hyperglycemia and induced more severe clinical manifestation. Recent review found that the use of glucocorticoid was not recommended to treat COVID-19 pneumonia and could cause harm [11].

Previous reported COVID-19 patients obtained a hydroxychloroquine therapy. In a small-randomized trial, COVID-19 patients with mild sign/symptom of pneumonia (by CT scan), received oral hydroxychloroquine 200 mg twice a day for five days. About 80.6% patients indicated improvement of COVID-19 pneumonia and

none developed severe COVID-19 pneumonia. Among COVID-19 patients with diabetes, hydroxychloroquine works as hypoglycemia agent by decreasing HbA1c and hyperglycemia [11]. COVID-19 patients with type 1 diabetes who receive Chloroquine therapy is potentially experiencing hypoglycemia as its side effect. Chloroquine agent has hypoglycemia and immunomodulatory effects, and therefore all patients should be closely monitored. In diabetic animals, Chloroquine causes an increase in the level of insulin serum by providing a signal to cellular receptors and post-receptor clearance [12]. All diabetic patients who receive hydroxychloroquine should obtain education on the contraindication such as diabetic neuropathy and history of seizure [7].

4.1.5. Diabetes education

Because of the COVID-19 pandemic, regular visit to hospital/

clinic by diabetes is impeded. Type 1-diabetes patients should contact endocrinologists while type 2 diabetes patients are suggested to consult with internal medical specialists or general practitioners [5,7]. It is recommended to conduct online or tele-consultation to keep in touch with the health care providers [7,8]. Endocrinologist could provide consultation by optimizing the use of smartphone application (i.e. WeChat, WhatsApps, Line) to share educational videos, e-books, and recommendations [8]. A previous meta-analysis showed that telemedicine practice during non-pandemic era by emails, phones, and videos, for 3–60 months in China showed significant reduction of HbA1c (-0.37% , $p < 0.001$) [18]. Another Cochrane review on telemedicine also indicated similar outcomes, i.e. decline in HbA1c of 0.31% ($p < 0.001$) [19]. A recent review on 46 studies on telemedicine among type 1 ($n = 2052$) and 2 diabetes ($n = 24,000$) patients showed significant reduction of HbA1c (-0.12% to -0.86% and -0.01 to -1.13% , respectively) [20].

A video mode of telemedicine is also recommended for the first consultation. Patient's privacy, confidentiality, and consent (from surrogates, caregivers or patients) should be maintained. Radiology, laboratory findings and prescription should be integrated in medical records. Previous history of complaint, allergy, and hypoglycemia are of main concern. Identification of any noticeable neurological deficit is applicable by requesting patients to perform simple neurological test. Video or photograph could help when suspecting any lesion on foot, abscess or visible wound. All patients should recognize sign/symptom of hypoglycemia and know how to treat it. Health care providers should always remind patients to do hand washing, cough technique and social distancing as general precaution during tele-consultation. When telemedicine or tele-consultation is not compatible, face-to-face clinic visit is acceptable by considering time and place for preventing transmission of Covid19. Telemedicine is also not doable for clinical examination and psychotropic/narcotic prescription [13].

4.1.6. Prevention of COVID-19 infection

As previously reported, patients with diabetes are at higher risk for COVID-19 infection. In general, diabetes patients should adhere to social distancing and home confinement policy as primary preventive method. They should avoid contacts or exposure with confirmed COVID-19 patients as much as they can. It is recommended that patients with diabetes should arrange an individual plan of diabetes management while staying at home or getting sick. They can make a to do list for dietary intakes, physical activities, and stress management during confinement. All diabetes patients are strongly recommended to keep maintaining their glycemic control as part of risk reduction of infection and/or prevent severe consequence of infection for confirmed COVID-19 patients with diabetes [5,8].

All diabetes patients should visit hospital to consult with physicians or nurses when they are suspected of COVID-19 infection. Fever and cough, dyspnea or pneumonia, visiting a pandemic area and recent contact with confirmed COVID-19 patients are factors for diabetes patients to be suspected as COVID-19 infection. When patients decide to go to hospital or clinic, patients with diabetes should use facemasks. They will undergo diagnosis procedure by taking samples from noses or throat [5].

In case of home confinement, patients and families should adhere to the rules for affected or suspected people because it could help to prevent further transmission to other patients and/or families. The affected people should live in a single room with proper ventilation, meanwhile other family members stay in different room. If this is not applicable, make sure to always keep a minimum 1-m distance from the affected person, routine hand washing after any contact with the affected patient or the

environment and use disposable paper towel or clean towel (and replace it when it is getting wet) after hand wash. The affected person should use medical mask to cover nose and mouth. All caregivers also need to wear full-covered medical mask when being in the same room with the affected person [5].

4.2. Specific consideration

Diabetes management is inevitably altered during the COVID-19 pandemic. Therefore, specific condition is required for specific circumstances. The following section will discuss diabetes management in a certain population or situation based on the current available evidences.

4.2.1. Diabetes in children and adolescents

In child or adolescent with newly diagnosed type 1 diabetes, it is recommended to take face-to-face mode of consultation. Type 1 diabetes patients and families should visit diabetes clinic to initiate insulin administration. Health care providers should make sure that patients and families receive diabetes education with highlighted topic on insulin administration, hypoglycemia and ketoacidosis sign/symptom and management. For the follow up of type 1-diabetes patients, ketoacidosis test should be advised when experiencing hyperglycemia [13].

4.2.2. Diabetes in pregnancy

All patients with gestational diabetes should undergo face-to-face consultation for insulin initiation during their first visit. Patients should obtain tailored education related their diabetes and current condition for lifestyle management. Minor adjustment of insulin dose may be necessitated for follow up gestational diabetes patients using telemedicine/tele-consultation [13].

4.2.3. Diabetes in elderly

Elderly patients with diabetes are more likely to have deteriorated glycemic control as result of raised blood glucose amid COVID-19 pandemic [7]. Hyperglycemia or hypoglycemia could occur due to limited access of care during lockdown and quarantine, which stimulate unstable blood glucose. It can lead to further serious complication for elderly patients with diabetes for example ketoacidosis, infection, coma hyperosmolar, and cardiac event. The drawback is more distinct among elder diabetic patients who live alone [2]. It is recommended to encourage them and always keep in touch with health care providers and quickly seek for help when needed.

4.2.4. Emergency or critical situation

All diabetic patients who are experiencing drowsiness, vomiting, chest pain, short of breath, limb weakness, and altered sensory should be noticed as emergency situation [9]. In addition, diabetic patients with any foot lesion, gangrene, severe hypoglycemia, gastroenteritis, and any other infection related to COVID-19 should be addressed for special condition. All of these situations require hospital/clinic visit or admission [13]. Health care providers should make sure diabetic patients understand about those signs/symptoms and take initial action to hospital/clinical appointment.

For confirmed COVID-19 patients with diabetes who receive critical care, intensive blood glucose monitoring should become priority of care. Adverse effect of drug reaction should be early identified [8]. Diabetes has noticed an independent factor of ICU admission and raised risk of mortality rate [3,7,11]. It was reported that COVID-19 patients with diabetes comorbidity had twice the risk to be admitted ICU and receive critical care [3]. Other study described that COVID-19 patients with diabetes contributed to

22.2%–58% of ICU admission due to septic shock and acute respiratory distress syndrome as result of blood glucose variability and elevated blood pressure [8,11]. The mortality risk of COVID-19 patients with diabetes is three times higher than non-diabetic patients [3]. Current reports noted the mortality rate of COVID-19 patients with diabetes was 7.3%–7.6% [8,11]. Thus, all health care providers should more concern when caring COVID-19 patients with diabetes during hospitalization.

4.3. Limitation

This is a scoping review to provide broader scope of diabetes management and action for particular consideration. Thus, there was no included level of evidence and quality evaluation. In addition, there was unclear methodological approach among included articles (author(s) did not definitely express the method section). Three included articles did not provide clear information about study design and data collection process. Five out of seven included articles did not specify the sample size and one article used one-sample size (case report). The limitation on the included studies causes a limitation for this scoping review.

5. Conclusion

This review produced a summary of diabetes management and specific considerations amid the COVID-19 pandemic for diabetes patients. Patients and family members could use this review to deal with diabetes management, concern on particular situations of diabetes, and seek for help when needed. Health care providers and policy makers could take concern on review results to facilitate people living with diabetes passing through the COVID-19 pandemic.

Funding

There is no funding available.

Availability of data and materials

Data are available by contacting the corresponding author with reasonable reasons.

Authors' contribution statement

ALW, NSH, AF designed study and guided methodology. ALW and NSH were responsible for searching, selection, data extraction and wrote the first draft. AF and RBP reviewed and discussed the manuscript. All authors approve and responsible for publication.

Ethic approval and participant consent

Not applicable.

Consent for publication

Not applicable.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Acknowledgments

We would appreciate librarians in Universitas Gadjah Mada, Indonesia that facilitate our review.

References

- [1] Hussain A, Bhowmik B, do Vale Moreira NC. COVID-19 and diabetes: knowledge in progress. *Diabetes Res Clin Pract* 2020 Apr 9;162:108142. <https://doi.org/10.1016/j.diabres.2020.108142>.
- [2] Singh AK, Gupta R, Ghosh A, Misra A. Diabetes in COVID-19: prevalence, pathophysiology, prognosis and practical considerations. *Diabetes Metab Syndr Clin Res Rev* 2020 Apr 9;14(4):303–10. <https://doi.org/10.1016/j.dsx.2020.04.004>.
- [3] Roncon L, Zuin M, Rigarelli G, Zuliani G. Diabetic patients with COVID-19 infection are at higher risk of ICU admission and poor short-term outcome. *J Clin Virol* 2020;127:104354. <https://doi.org/10.1016/j.jcv.2020.104354>.
- [4] Hill MA, Mantzoros C, Sowers JR. Commentary: COVID-19 in patients with diabetes. *Metabolism* 2020 Mar 24;107:154217. <https://doi.org/10.1016/j.metabol.2020.154217>.
- [5] Puig-Domingo M, Marazuela M, Giustina A. COVID-19 and endocrine diseases. a statement from the European Society of Endocrinology. *Endocrine* 2020 Apr 11;68:2–5. <https://doi.org/10.1007/s12020-020-02294-5>.
- [6] Li B, Yang J, Zhao F, et al. Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. *Clin Res Cardiol* 2020 Mar 11;109:531–8. <https://doi.org/10.1007/s00392-020-01626-9>.
- [7] Banerjee M, Chakraborty S, Pal R. Diabetes self-management amid COVID-19 pandemic. *Diabetes Metab Syndr Clin Res Rev* 2020 Apr 13;14(4):351–4. <https://doi.org/10.1016/j.dsx.2020.04.013>.
- [8] Wang A, Zhao W, Xu Z, Gu J. Timely blood glucose management for the outbreak of 2019 novel coronavirus disease (COVID-19) is urgently needed. *Diabetes Res Clin Pract* 2020 Mar 13:162. <https://doi.org/10.1016/j.diabres.2020.108118>.
- [9] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2007 Feb 23;8:19–32. <https://doi.org/10.1080/1364557032000119616>.
- [10] Moher D, Liberati A, Tetzlaff J, Altman DG. The PRISMA Group. Preferred reporting items for systematic review. *Ann Intern Med* 2009;151(4):264–9. <https://doi.org/10.7326/0003-4819-151-4-200908180-00135>.
- [11] Brufsky A. Hyperglycemia, hydroxychloroquine, and the COVID-19 pandemic. *J Med Virol* 2020 Apr 15;92:770–5. <https://doi.org/10.1002/jmv.25887>.
- [12] Baretic M. Case report of chloroquine therapy and hypoglycaemia in type 1 diabetes: what should we have in mind during the COVID-19 pandemic? *Diabetes Metab Syndr Clin Res Rev* 2020 Apr 13;14(4):355–6. <https://doi.org/10.1016/j.dsx.2020.04.014>.
- [13] Ghosh A, Gupta R, Misra A. Telemedicine for diabetes care in India during COVID-19 pandemic and national lockdown period: guidelines for physicians. *Diabetes Metab Syndr Clin Res Rev* 2020 Apr 4;14(4):273–6. <https://doi.org/10.1016/j.dsx.2020.04.001>.
- [14] American Diabetes Association. Summary of revisions: standards of medical care in diabetes-2019. *Diabetes Care* 2019 Jan;42(Supplement1):S4–6. <https://doi.org/10.2337/dc19-Srev01>.
- [15] American Diabetes Association. Lifestyle management: standards of medical care in diabetes-2019. *Diabetes Care* 2019 Jan;42(Supplement1):S46–60. <https://doi.org/10.2337/dc18-S004>.
- [16] American Diabetes Association. Diabetes care in the hospital: standards of medical care in diabetes-2019. *Diabetes Care* 2019 Jan;42(Supplement1):S173–81. <https://doi.org/10.2337/dc19-S015>.
- [17] Putranti DP, Pulo EO, Arita C, Wicaksana AL. Effect of yoga on pulmonary function among asthmatic patients: a protocol synthesis. *Enferm Clin* 2020 Apr 21;30(Supplemen3):136–42. <https://doi.org/10.1016/j.enfcli.2019.12.044>.
- [18] Zhai YK, Zhu WJ, Cai YL, Sun DX, Zhao J. Clinical- and cost-effectiveness of telemedicine in type 2 diabetes mellitus: a systematic review and meta-analysis. *Medicine* 2014 Dec;93(28):e312. <https://doi.org/10.1097/MD.0000000000000312>.
- [19] Flodgren G, Rachas A, Farmer AJ, Inzitari M, Shepperd S. Interactive telemedicine: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev* 2015 Sep 7;9:CD002098. <https://doi.org/10.1002/14651858.CD002098.pub2>.
- [20] Timpel P, Oswald S, Schwarz PEH, Harst L. Mapping the evidence on the effectiveness of telemedicine interventions in diabetes, dyslipidemia, and hypertension: an umbrella review of systematic reviews and meta-analyses. *J Med Internet Res* 2020 Mar 18;22(3):e16791. <https://doi.org/10.2196/16791>.