



Nursing interventions for people living with metabolic syndrome:

A literature reviews

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Abstract

Background: Metabolic syndrome (MetS) is a cluster of abnormalities that adversely affects overall human health. It is composed of interrelated risk factors including obesity, insulin resistance, dyslipidemia, and hypertension. These risk factors increase the chances of heart disease, diabetes mellitus, and stroke. Nursing intervention for MetS varies and there is no consensus on a conventional nursing intervention for MetS.

Aim: The review aimed to examine various available nursing interventions and describe their impact on the health and wellbeing of MetS patients in different settings.

Method: A literature review was conducted from a search of three major research databases, including Cinahl (Ebsco), PubMed, and Medline. The articles selected were reviewed and analyzed through inductive content analysis.

Results: This review highlighted different nursing interventions for people living with MetS. The review analysis shows that non-conventional nursing interventions are more efficient nursing interventions for taking care of people living with MetS. Fasting plasma glucose among MetS patients with diabetes was significantly improved through non-conventional monitoring system, improved adherence to treatment plan and reduced treatment boycott or discontinuation among patients.

There was significant improvement in body weight, abdominal obesity, and total body weight among MetS patients with obesity. Non-conventional nursing intervention ensures increased physical activity level, promotes better eating habits, and improves compliance to exercise routine.

Non-conventional health education through modern technology and innovations promotes health knowledge among MetS patients. This has direct impacts on the level of anxiety, depression, fear and apprehension that are due to poor health knowledge about their disease.

People living with MetS who suffer from poor blood lipid profile such as high cholesterol level, low hdl (high density lipoprotein) and high ldl (low density lipoprotein) observed notable change in their health profile. Other variables such as sitting habit, smoking, hygiene, and foot-care were impacted positively.

Conclusion: If the health system is to holistically cater for people living with Mets and ensure the best possible outcomes, precise and effective nursing interventions are inevitable. This literature review has provided insight into possible interventions to promote patients' health and wellbeing.

Keywords

Metabolic syndrome, nursing intervention, obesity, nursing, diabetes, dyslipidaemia, hypertension, insulin resistance, nursing care, nursing education.

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1 Introduction

Metabolic syndrome (MetS) according to American Heart Association (AHA) and the National Heart, Lung, and Blood Institute (NHLB), is an aggregate of risk factors including, insulin resistance, dyslipidaemia, hypertension, and obesity and its central distribution (American Heart Association, 2016). Metabolic syndrome is a major public health problem worldwide and it is highly prevalent in the adult population, ranging from 10% to 30% in Europe, from 34% to 42% in the United States, and increasing dramatically in older groups (Lanktree & Hegele, 2018). The risk of coronary heart disease, stroke, non-alcoholic fatty liver disease, diabetes mellitus type 2 (T2DM), and other forms of cardiovascular diseases, have been linked to MetS (Haverinen et al., 2021). MetS is associated with variables such as sociodemographic factors including age, education, marital status, and housing (Moore et al., 2019).

The emergence and continued prevalence of novel Coronavirus Disease 2019 (COVID-19) adversely imply people living with Mets. While the variables for the susceptibility to the virus are still under active research. Age and underlying or pre-existing conditions are established factors that put someone at elevated risk of severe outcomes and death due to Covid-19. For instance, people with an elevated risk for an adverse prognosis of severe acute respiratory syndrome-Coronavirus-2 (SARS-CoV-2) were described to have pre-existing conditions like cancer, chronic respiratory disease, diabetes, cardiovascular disease, or hypertension, as well as being elderly (Alamdari et al., 2020).

It is estimated that individuals with MetS following diabetes mellitus type 2 might have up to ten times greater risk of death due to COVID-19 (Alamdari et al., 2020). Hyperglycaemia and obesity were identified as independently important predictive factors of mortality and morbidity in cases with COVID-19 in New York City. It seems that the risen prevalence of MetS in older COVID-19 patients in Iran and Italy, in comparison to China, could be the cause of differences in mortality between the countries (Alamdari et al., 2020). The pathogenesis of MetS is an ongoing research area, not yet completely understood (Hu et al., 2008). However, the likelihood of acquiring Mets increases with factors such as being overweight or obese, insulin resistance, Caucasian race, and male gender (Falkner & Cossrow, 2014a; Ramirez et al., 2018; Su et al., 2020).

Despite pieces of evidence of the prevalence and devastating health effects of MetS, nursing interventions for MetS are diverse and an existing knowledge gap exists in nursing care approaches (Félix & da Nóbrega, 2019; Poljičanin et al., 2012a). Thus, enhanced knowledge of evidence-based interventions among nurses will lead to an enriched care plan that improves early detection and prevent or delay full-blown syndrome among people living with MetS. This review, therefore, aims to highlight the evidence-based nursing interventions for people living with Mets.

2 Metabolic syndrome

2.1 The global prevalence of the metabolic syndrome

Individuals who experience abnormal levels of three of the five risk criteria (obesity, hypertension, triglyceridaemia, abnormal cholesterol, diabetes), are having MetS (Paley & Johnson, 2018). MetS was primarily described by Gerald Reaven in 1988, and was named “Syndrome X,” which comprised insulin resistance, hypertension, dyslipidemia, and diabetes mellitus, and did not include obesity (Roberts et al., 2013). However, obesity is currently considered one of the basal pathogenic factors. The joint AHA/NHLBI scientific statement, published September 12, 2005, also identifies the dominant underlying risk factors like abdominal obesity and insulin resistance (Falkner & Cossrow, 2014).

In Finland, MetS was also described as a common phenomenon in the middle-aged Finnish population. It was found to be prevalent in both men and women alike, but greater in middle-aged men than in women. The difference between sexes exists independently of the clinical definition of the syndrome (Vanhala et al., 2016). The elderly population study conducted between 1990 and 2008 in Oulu, Finland also found a significant prevalence of MetS with the most common component or risk being elevated blood pressure, glucose abnormality, and central obesity (Saukkonen et al., 2012). Dyslipidaemia, low HDL cholesterol, insulin resistance presenting as abnormal glucose tolerance, and hyperinsulinemia, were the major MetS risk factors found in the Finnish study held in Oulu. Prevalence in both sexes was found to be 17% of men and 8% of women. Central obesity was more common among women, whilst dyslipidaemia and insulin resistance were more prevalent among men (Saukkonen et al., 2012; Vanhala et al., 2016).

The risk of developing MetS is also high among pregnant women with gestational diabetes. A study of the prevalence of MetS, 7 years postpartum among Finnish women with gestational diabetes mellitus risk factors during pregnancy shows that increased pregnancy BMI was associated with MetS (Puhkala et al., 2017). The number of people living with MetS is increasing worldwide, along with the obesity epidemic and population aging. Estimates of MetS prevalence vary between 15% and 34% in adult populations, and around 8–19% in reproductive-aged women in industrial countries (Puhkala et al., 2017). Contrary to earlier research, MetS is no longer a public health problem of developed nations, as a rising trajectory has been established in Africa, India, and other

low-income countries (Gharipour et al., 2015; Okafor, 2012). The increase in popularity of western diet and lifestyle changes have been pointed out as some of the key causative factors to the increment in the incidence of Mets among these populations. For instance, the highest prevalence among African nations is in Southern Africa, followed by Eastern, Western, and Central Africa. The most common occurring component of Mets found among African populations are obesity and dyslipidemia (Jaspers Fajjer-Westerink et al., 2020). Below is a chart from randomly selected countries of the world and the level of prevalence of MetS among their population.

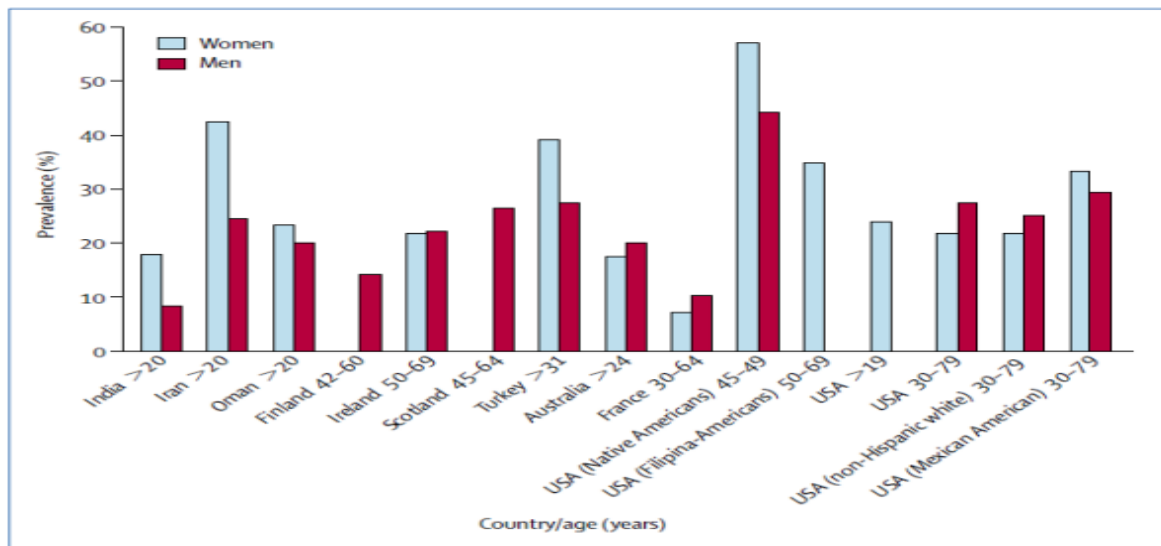


Figure 1 MetS prevalence in worldwide populations (Eckel et al., 2005).

The prevalence of Mets in randomly selected countries was described in figure 1 above, distributed along age and gender. The highest prevalence was recorded among the American population followed by Iran and Turkey. There was a similar trend in the prevalence of Mets among these countries despite the sharp contrast that exists in their economic and social-cultural values and norms.

2.2 Diagnoses of metabolic syndrome

MetS diseases risk factors are diagnosed differently depending on the working definition adopted by the organization or medical centres. The three most popular definitions relevant to this literature review (see table 1 below) were taken from world health governing bodies (World Health Organization (WHO), National Cholesterol Education Program (NCEP), and International Diabetes Federation (IDF)). They are globally accepted definitions, and resources for a nursing care plan,

diagnoses, and management of a patient's health and well-being. (Grundy et al., 2005; Saklayen, 2018).

Table 1 Different nursing diagnostic criteria for MetS (Saklayen, 2018)

World Health Organization 1999
<ul style="list-style-type: none"> ○ Presence of insulin resistance or glucose > 6.1 mmol/L (110 mg/dl), 2 h glucose > 7.8 mmol (140 mg/dl) (required) along with any two or more of the following. ○ HDL cholesterol < 0.9 mmol/L (35 mg/dl) in men, < 1.0 mmol/L (40 mg/dl) in women. ○ Triglycerides > 1.7 mmol/L (150 mg/dl) ○ Waist/hip ratio > 0.9 (men) or > 0.85 (women) or BMI > 30 kg/m² ○ Blood pressure > 140/90 mmHg
NCEP (National Cholesterol Education Program) ATP3 2005
<ul style="list-style-type: none"> ○ Blood glucose greater than 5.6 mmol/L (100 mg/dl) or drug treatment for elevated blood glucose ○ HDL cholesterol < 1.0 mmol/L (40 mg/dl) in men, < 1.3 mmol/L (50 mg/dl) in women or drug treatment for low HDL-C ○ Blood triglycerides > 1.7 mmol/L (150 mg/dl) or drug treatment for elevated triglycerides ○ Waist > 102 cm (men) or > 88 cm (women) ○ Blood pressure > 130/85 mmHg or drug treatment for hypertension
IDF (International Diabetes Federation) 2006
<ul style="list-style-type: none"> ○ Waist > 94 cm (men) or > 80 cm (women) along with the presence of two or more of the following: ○ Blood glucose greater than 5.6 mmol/L (100 mg/dl) or diagnosed diabetes ○ HDL cholesterol < 1.0 mmol/L (40 mg/dl) in men, < 1.3 mmol/L (50 mg/dl) in women or drug treatment for low HDL-C ○ Blood triglycerides > 1.7 mmol/L (150 mg/dl) or drug treatment for elevated triglycerides ○ Blood pressure > 130/85 mmHg or drug treatment for hypertension

General health diagnostic protocols state the range of values for the risk factors. There are slight variations in the risk factors considered primarily as deterministic of MetS. Simple set of diagnostic criteria based on common clinical measures including waist circumference, triglycerides, HDL-C, blood pressure, and fasting glucose level. The presence of defined abnormalities in any three of these five measures constitutes a diagnosis of the MetS (Lanktree & Hegele, 2018; Ruderman & Shulman, 2015).

MetS thrive on the spread of its component non-communicable diseases such as diabetes, high cholesterol, high blood pressure, and obesity. Conversely, a healthy diet, exercise, and weight loss are protective factors against the development of MetS (AHA, 2016). Inadequate nutrition and physical inactivity are the most common antecedents of the syndrome, and the utmost implications are occurrences of cardiovascular disease and type2 diabetes mellitus (Félix & da Nóbrega, 2019). The common approach to diagnosing Mets is to identify two to three components of Mets using one or more of the standard definitions. When this is done in time and successfully it could help to remediate the disease and curtail Mets before it becomes full-blown. Table 1 above shows three different criteria for diagnosing Mets.

2.3 Causes and effects of metabolic syndrome

Although many people may be genetically susceptible to Mets, rarely does it become clinically manifested in the absence of some degree of obesity and physical inactivity (Locke et al., 2015; Paley & Johnson, 2018). Conversely, a healthy diet, exercise, and weight loss are protective factors against the development of MetS (Outland, 2018; Paley & Johnson, 2018; Roberts et al., 2013). The incidence of obesity in some cases does not equate to the incidence of metabolic disease, there are cases of so-called metabolically healthy obese, who are MetS-free or asymptomatic. However, second to genetic features, an obesogenic lifestyle, defined as an unhealthy diet and physical inactivity increase the risk of MetS (Locke et al., 2015; Paley & Johnson, 2018).

Obesity was known to be common among wealthy nations; recent data however show a change in this common trend. There are increased and growing incidences of obesity among low-income nations and even among the poor group or societies within high-income countries (Gharipour et al., 2015). Hence, obesity is not only related to access to excess food anymore but rather to a general lifestyle and perhaps genetic components (Haverinen et al., 2021; van Vliet-Ostaptchouk et al., 2014). Dyslipidaemia is the presence of hypertriglyceridemia, low HDL cholesterol, or both. Adipocytes are fat cells in the body that make up a substantial proportion of the human body composition. Hypertriglyceridemia, an increase in the number of certain types of adipocytes (low HDL cholesterol) is biologically unhealthy. An increase of adipocytes in certain body organs (liver) or tissues (blood and muscle) could be a marker for the presence of diseases and comorbidities such as Mets and other fat-related illnesses like fatty liver (Chait & den Hartigh, 2020).

A low level of high-density lipoprotein (HDL) the so-called good fat is as well an unhealthy health parameter. Some fat-related variables that have shown some level of health benefits are the increased level of HDL and an increase in brown adipocytes. The presence or absence of the various types of lipids molecules dictates the functionality of many organs and tissues of the body, especially the ones responsible for energy metabolism regulation. Dyslipidaemia as a component of MetS contributes largely to the coronary artery disease symptoms commonly found among people living with Mets. (Chait & den Hartigh, 2020; Cornier et al., 2008).

MetS is a complex pathophysiological condition, and its component disease interconnectedness makes the diagnoses and treatment challenging. High blood pressure is linked to cardiovascular vessel dysfunction. Increased body weight due to weight gain because of a high-fat diet, excess salt, cholesterol, and physical inactivity is implicated in most cases of MetS. For instance, in Finland the most common individual component of MetS in the elderly population is linked to hypertension in both men and women, the prevalence of hypertension was 80 – 90%. The figure is higher compared to their nearest neighbour, Sweden. The Swedish population has an estimated prevalence of Mets at 68% in men and 58% in women aged 70 years (Saukkonen et al., 2012).

The core metabolic abnormality in MetS is insulin resistance or impaired insulin-mediated glucose regulation that results in elevated plasma insulin concentration. MetS greatly increases the risk for diabetes, atherosclerosis, and adverse metabolic and cardiovascular outcomes. Insulin resistance defined as abnormal glucose tolerance, hyperinsulinemia, or both, is one of the hallmarks of MetS. Insulin resistance and ultimately type2 diabetes are central drivers in the pathogenesis of the metabolic disease (Falkner & Cossrow, 2014b).

According to CDC data published in 2017, about 30.2 million adults aged 18 years or older, or 12.2% of USA adults had type 2 diabetes (T2DM). In Finland, type-2 diabetes mellitus is a major health challenge, especially among the adult and elderly population. (Chait & den Hartigh, 2020; Lakka et al., 2002; Saukkonen et al., 2012). The prevalence, as well as the actual number of people with type 2 diabetes, has been increasing in Finland during the past decades, in parallel with an increase in overweight and obesity. Besides obesity, population aging is one of the main drivers of the increasing number of diabetic patients ((Arffman et al., 2020; THL. 2022). The figure 2 below depicts the trend of diabetes cases in Finland since 1960 to 2020.

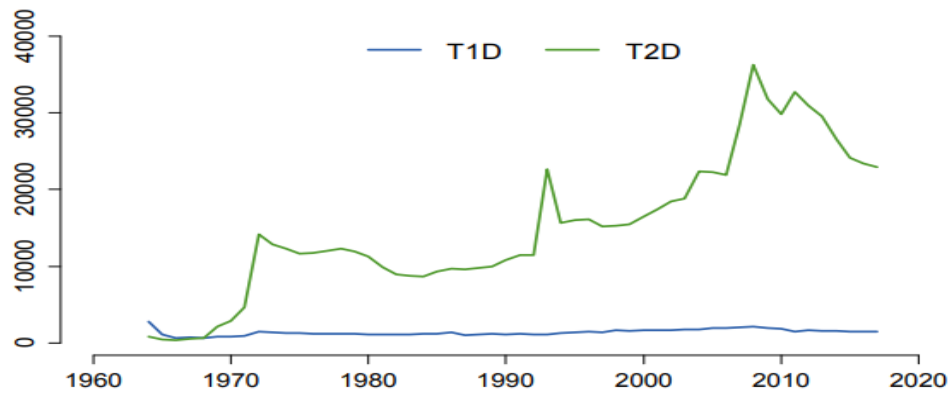


Figure 2 Trend of diabetes cases in Finland (Arffman et al., 2020).

Incident number of persons with type 1 diabetes (T1D) and type 2 diabetes (T2D) in Finland between the periods of 1964 – 2017. The graph shows a consistent increase in the number of people living with Mets among the Finnish population. The peak prevalence was observed in the year 2010. Different private and government agencies' effort since then has proven to be beneficial. There is a gradual decrease in the rate of prevalence observed since 2010 to date. However, the number of people living with Mets is on the decline, the current Mets prevalence rate at 17.7 to 43.0% is still high when compared to other developed countries. The downward trend in the prevalence of Mets, therefore, needs to be sustained.

2.4 Nursing skills and knowledge

Digital care, self-care, nurse–lead and community-based approaches are some of the common settings of nursing intervention of MetS (Uusitupa et al., 2019). Regardless of the type of intervention the primary goal of nursing intervention for MetS is a holistic care plan that would promote and enhance patients' general health and well-being (Jenum et al., 2019). The intervention for people living with MetS begins with identifying risk factors; these include central obesity, hypertension, dyslipidemia, insulin resistance, elevated fibrinogen levels, and or prothrombotic state (Jenum et al., 2019; Poljičanin et al., 2012b). The nursing intervention process also includes developing management strategies including nursing educating, planning and recommending physical exercise, dietary planning and education, psychosocial support, and medication. These help patients to avoid the onset or worsening of individual risk factors. Together, these steps taken by the nurse would help reduce long-term morbidity and mortality associated with MetS (Jenum et al., 2019; Poljičanin et al., 2012b; Uusitupa et al., 2019).

Adequate nursing knowledge and experience of the pathophysiological characteristics of MetS by nurses would influence largely the intervention plan taken to mitigate the disease (Spencer et al., 2015). Nurses should be aware of and appreciate the importance of nursing education, diet, and weight management benefits for reducing the devastating effects of MetS. If nurses taking care of people living with MetS have the know-how in this area. They can pass to their patients, the knowledge that would instil responsible actions to prevent the MetS disease from worsening (Jenum et al., 2019; Uusitupa et al., 2019).

Care plans for individuals living with MetS should be holistic and patient centred. The patient sociodemographic background, sex, age, and ethnicity are considered (Poljičanin et al., 2012b). It could be that some individuals or ethnic groups (for example, Asians) will develop characteristics of insulin resistance and MetS with only moderate increases in waist circumference (Uusitupa et al., 2019). Management of atherogenic dyslipidaemia, hypertension, and impaired glucose regulation, prevention of type 2 diabetes for individuals who do not yet have the disease, and the intervention should emphasize therapeutic lifestyle changes to mitigate obesity, physical inactivity, and atherogenic diet (Spencer et al., 2015; Uusitupa et al., 2019).

3 Study aims and purpose

This study aimed to identify nursing interventions for people living with MetS. The purpose was to contribute to the knowledge and awareness of nurses about MetS' nursing interventions.

Research question: what are the nursing interventions for metabolic syndrome?

4 Methodology

4.1 Literature review

This thesis is a literature review of studies on nursing intervention for people living with MetS. A literature review is a process of reading, analysing, and writing a synthesis of scholarly material about a specific topic. According to Fink (2009), it is a systematic method for identifying and evaluating an existing body of work produced by researchers and scholars (Tricco et al., 2016; Zainuddin et al., 2019). There are different forms or approaches to a literature review; they include narrative, problem identification, rational thinking, and reflective oversight (Machi & McEvoy, 2016; Slocum & Rolf, 2021; Tricco et al., 2016; Zainuddin et al., 2019).

The basic objective of a literature review is to provide answers to a hypothetical research question. A broader scope of a literature review may include distinguishing what has been undertaken and what needs to be undertaken. To identify variables that are relevant to a research topic. Identify relationships between theory/concepts and practice. Distinguishing exemplary research and avoiding unintentional and unnecessary replication. Identifying the main research methodologies and designs utilized. To identify contradictions and inconsistencies. To identify strengths and weaknesses of the various research approaches that have been utilized previously and make way for novel and innovative approaches. (Onwuegbuzie et al., 2012; Slocum & Rolf, 2021).

In consonant with Randolph's (2009), five steps to conducting a literature review, this work begins with the formulation of a problem in form of a research question based on the research aims and objectives. The study proceeded to an elaborate search of relevant databases for studies on the research topic and subject area. This was followed by data evaluation via appraisals, validity, reliability, and ethical consideration. The data was then analysed using the content analysis method. The detail of the processes and steps relating to the literature database search, data evaluation, data analysis, result, discussion, and recommendation are presented in the preceding paragraph.

4.2 Literature search

Fraenkel and Wallen (2006) identified six steps for a good literature search: Defining the research problem as precisely as possible, looking at relevant secondary sources, and selecting and perusing one or two appropriate general reference works. Formulate search terms (keywords or phrases)

based on the research question of interest. Search the general references for relevant primary sources. Obtain and read relevant primary sources and note and summarize key points in the sources (Onwuegbuzie et al., 2012).

The article selection was made by searching CINAHL (EBSCO), PubMed, and Medline databases. The search was done with keywords generated through a well-developed PICO table (see Table 2). The combination of search terms used in the data search is presented in (Table 3) below.

Table 2 Pico table for system database search

Population	Adult patient population
Intervention	Nursing interventions
Comparison/ Context	Metabolic syndrome
S- studies	In English, published 2012- 2022, peer-reviewed, availability of abstract and full-text.

Table 3 Search terms used in the databases

Database	Search term
PubMed	Patient or Client AND Nurse OR Nursing or Nurses AND Metabolic Syndrome
CINAHL (EBSCO)	Patient OR Client OR Individual AND Nurse OR Nursing OR Nurses OR Nursing care OR Nursing staff AND metabolic syndrome OR metabolic disease
Medline	Patient OR Client OR Individual AND Nurse OR Nursing or Nurses AND Metabolic Syndrome OR Metabolic disease

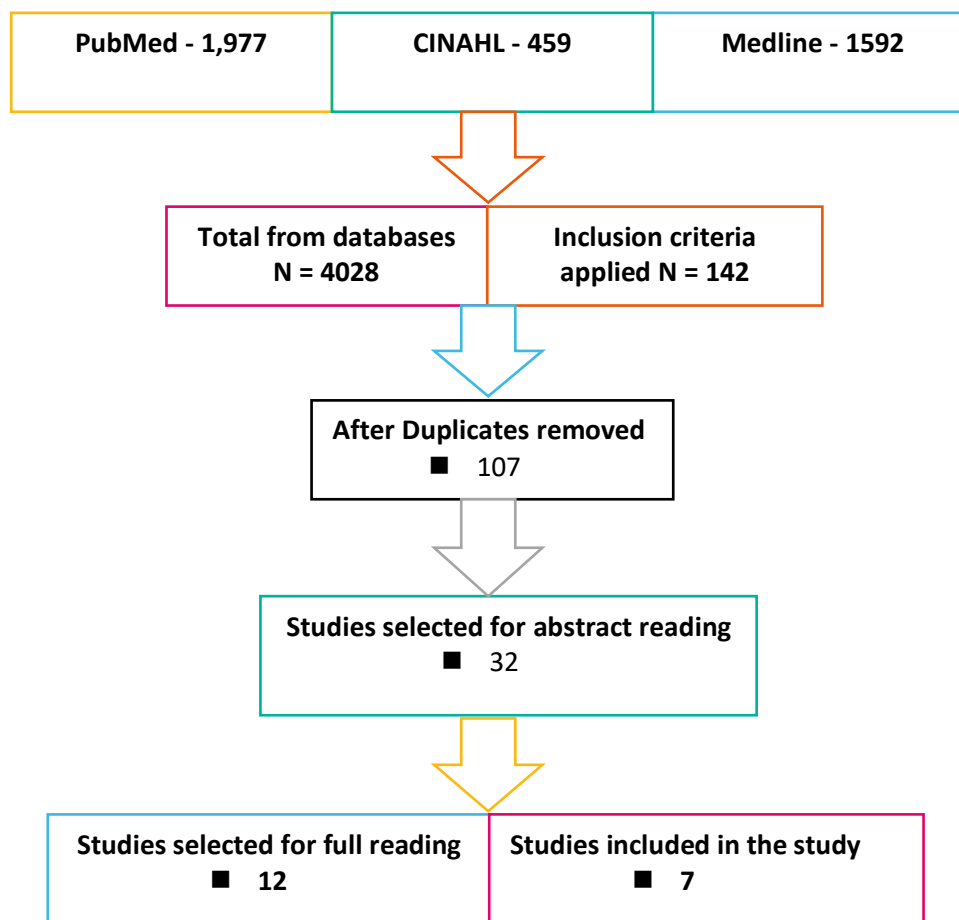
Pieces of literature included in this study were screened against the inclusion and exclusion criteria. Initially, duplicates were eliminated, then studies were screened using title and abstract, and later, full-text screening was done. Seven studies were screened for analysis. The flow chart (see figure 2 below) shows the process of data screening and article selection for data analysis in this study.

Table 4 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Study in English	Studies in other languages
Original studies	Systematic review, Meta-analysis
Peer-reviewed studies	Non-peer reviewed
Published between the years 2012 and 2022	Older than 10years
Full-text access	No full-text access
Answers to the research questions	Not relevant to the research question

Included studies were those that met the following inclusion criteria, studies that were published between 2012 and 2022, written in the English language, peer-reviewed, original studies, that included adult patient population and were full text. Studies that did not meet the inclusion criteria were not considered (See Table 4) above.

Figure 3 Article search and studies selection



4.3 Data analysis

Analysis means breaking down a whole into its components or constituent parts. Through the assembly of the parts, one comes to understand the integrity of the whole (Onwuegbuzie et al., 2012). A broad outlook of analysis takes two major forms: a within-study literature analysis or a between-study literature analysis. A within-study literature analysis involves analysing the contents of a specific work. (Onwuegbuzie et al., 2012; Tricco et al., 2016; Zainuddin et al., 2019). In contrast, a between-study literature analysis compares data from two or more literature sources. Essentially every component, or at least multiple components, of works is compared (Onwuegbuzie et al., 2012). This is the approach suitable, therefore used for the analysis of this study.

In summary, the analytic procedure adopted in this study involved the between-study literature analysis using the content analysis method. Content analysis is the process, systematic and objective means of describing and quantifying phenomena. Content analysis allows the researcher to test theoretical issues to enhance understanding of the data. Through content analysis, it is possible to distil words into fewer content-related concepts and sub-concepts to draw up an empirical meaning or inferences from the data. It is assumed that when data are classified into the same concepts, words, and phrases of their likes, share the same meaning (Elo & Kyngäs, 2008; Slocum & Rolf, 2021).

There are two broad approaches to content analysis. These are inductive and deductive analyses. The choice of approach is dependent on the amount of information or knowledge that is already available about the subject. A mature subject area favours deductive, while a fragmented subject suits the inductive content analysis method (Elo & Kyngäs, 2008; Slocum & Rolf, 2021). The approaches have similar basic procedures. This study, however, uses the deducted content analysis; the aim is to evaluate existing data and knowledge about nursing interventions for people living with Mets for which there is a substantial number of relevant studies.

No new data was collected for this review. Rather data used were collected from the selected studies. The analytic process followed the path of concept testing in the selected research studies as follows: Selection of the content to be analysed, the definition of units and concepts of analysis, and development of a set of coding rules to arrive at the main concept. The results, discussion, conclusion, and recommendations are then presented at the end of the research work.

The seven articles included in this study were published between 2010 – 2022 in Spain (2), China (3), New Zealand (1), and Taiwan (1). The studies were composed of qualitative, quantitative, and mixed methods. The result of the content analysis revealed different sub-concepts. These sub-concepts are building blocks for a broader concept of nursing care procedure and ultimately different types of nursing intervention that later emerged throughout the analytic process.

Table 5 Units and concepts of analysis / Outcome of content analysis

Open code	Sub-concept	Concept	Main Concept
telephone coaching, health talk, MetS App, telephone counseling, dietary habits, healthy menus, physical exercise prescription, mobile application use, use of the internet, health and physical exercise videos, group physical exercise, sedentary behavior, depressive symptoms, encouragement, guidance, decision support, empowerment, compliance, glycemic control, obesity, weight loss; behavioral group,	health education medication physical exercise psychotherapy diet and nutrition	Nursing care procedures	Nursing care procedure for metabolic diseases
On-site nursing care protocols Test and measurement	Routine nursing care Standard guideline care	Conventional nursing care intervention	Nursing Interventions for metabolic disease
Self-blood glucose measurement and titration, self-insulin administration	Guided care Individualized care Self-management care	Non-conventional nursing care intervention	

Table 5 above shows three main concepts of nursing interventions namely, nursing care procedure. This main concept highlights general nursing care modalities. While the other two main concepts, conventional and non-conventional nursing intervention depict the differences in the nursing care modalities adopted for the nursing care plan and intervention. The detail of the research analysis is presented below.

Table 6 The indicator relating to the main concept

Nursing procedure Concepts	Conventional nursing intervention	Non-conventional nursing intervention
Health education	Brochure, booklet, verbal, leaflet, telephone, written prescription of the recommended diet and exercise.	Group education, mobile app, internet-based material, nurse-led telephone counseling, motivational interview
Diet and nutrition	General diet plan, self-managed, a booklet for nutritional guide,	Personalized nutrition programs, nutritionist-led intervention, nurse monitored, structured programs,
Physical exercise	Running, gym visits, self-practice, hospital appointments, verbal advice to exercise, a booklet for exercise guide,	Prescribed individualized exercise, Tailored exercise, strength combined with aerobic exercise, outdoor activities, led by exercise therapist, Structured exercise plan, Group exercise practice, exercise app, internet-based exercise training, and body weight monitoring system.
psychotherapy	Not included in the care plan, or addressed by nurse's verbal words	Psychologist-led, measured by standardized tools, personalized therapy
Medication	Oral medication, basal insulin titration	Basal insulin titration
Glucose monitoring	Self-monitor, automatic monitoring device, eAg measured	Patient and nurse collaborative monitoring, family support, HbA1c were measured.

5 Result

Preventing and managing MetS is a major concern with the growing numbers of people living with diabetes mellitus. Nursing care procedures emerged as one of the main concepts in the analysis of studies in this review. It comprised sub-concepts that form the processes of nursing intervention for patients living with MetS. These include health education, physical exercise, diet and nutrition, psychotherapy, and medication. Presented below, therefore, are the reported impacts of different nursing care procedures and modalities adopted during conventional and non-conventional nursing interventions.

Health Education

The major goal of nursing intervention for people living with MetS is lifestyle modification. Health education is a major nursing care tool deployed to instil lifestyle modification. Health education is an essential part of the nursing care management of MetS and a powerful risk reduction intervention. Health education as a nursing intervention tool for managing MetS traditionally uses a booklet, brochure, and face-to-face verbal instruction within the hospital setting. These happened usually at the point of admission into the hospital, during discharge from the hospital, or after consultation during hospital visits. For instance, Hu et al. (2018) in research among the patient living with type-II-diabetes. Explained that while >75% of healthcare professionals discussed basal insulin titration at the initiation visit, only 16% to 28% of patients remembered such discussions, many (32–42%) were unaware of the need to titrate basal insulin for diabetes control and management

Comparing the effects of a MetS mobile app versus the use of an educational booklet, Wong et al. (2021) reported improved health outcomes in most of the indices measured in their study. Despite the app containing the same information as the booklet, there were marked differences in the outcome of the groups. The mobile app group showed significant improvement in body weight, BMI, physical activity level, and increased exercise self-efficacy (Mi et al., 2021). The study gives credence to the evolution of E-health technology, the use of information and communication technologies to improve health care. Using the internet combined with exercise-based individualized nursing intervention, Chen et al. (2021) offered a hospital-provided network platform where patients and their caregivers can access health services by booking appointments online for questions and concerns. Specialists and nurses tailored the nursing intervention to each patient's peculiarities.

They also provided real-time guidance on glucose control, exercise, and other relevant health details while following up on the patient's glucose levels.

The intervention allows patients to enjoy professional guidance and get help from the medical staff at home anytime, which is a favourable treatment for those who require effective continuous treatment and nursing care. Compared to conventional on-site treatment or hospital visits. The internet-nursing mode improved access and enhance nursing education. Combine with an individualized physical exercise program, the nursing intervention resulted in significant improvement in all the indices measured during the study, such as lower blood lipid, lower blood pressure, reduce adverse pregnancy outcomes, and improved insulin sensitivity. More importantly, patients reported a higher level of nursing care satisfaction compared to the control group.

Adopting a non-conventional health education tool like decision-supported telephone coaching (regular weekly telephone calls for follow-up and treatment guidance) to combat the high level of non-compliance or negligence was effective in promoting patient empowerment, self-care, and the development of the innate capacity of responsibility through education. There was reported improvement in glycaemic control among the experimental group compared to the control group. The research also reported positive results on other physiological and psychosocial indices measured compared to the conventional care of onsite verbal instruction and telephone call follow-up. Patients reported improvement in self-management empowerment relating to diet, exercise, and blood glucose monitoring). This study demonstrated that insulin dose titration by the patient, assisted by the nurse, is effective and useful in reducing MetS prevalence (Hu et al., 2021).

Motivational counselling as a form of nursing education for patients of MetS reported significant improvement in sedentary behaviour and depressive symptoms in the intervention group. Sedentary behaviour measured as weekly sitting time, and depressive symptom assessed via Beck Depression Inventory showed that patients who received motivational counselling combined with a health education brochure decrease sedentary activities including time spent sitting, watching television, using mobile devices, computers, or other forms of screen-based entertainment. Motivational counselling also increases the frequency of breaks during the time spent on those sedentary behaviours (Chiang et al., 2019).

The group intervention in obesity (IGOBE) provides a clinical setting that goes beyond a booklet or verbal health education. It provided an environment for the exchange of ideas and self-expression, ensure active participation and encourage interaction. The intervention adopts a structured program of nutrition education for obese patients based on group care. It promotes the consumption of a healthy diet, performance of prescribed exercises, and provision of behavioural support in a clinical real-life setting of adults with obesity. It also provided a social support system through the establishment of e-mail support and a website containing information about healthy recipes. The intervention reported a significant improvement in the patient's knowledge, skills, and resources needed to develop good behaviours and live a healthier lifestyle. It leads to diminished false beliefs and a significant reduction in MetS prevalence and better control of MetS features compared with the standard care approach (Tejera et al., 2022).

All the research reports emphasized and proved that digital or electronic health-related decision aids improve knowledge of treatment options, provide realistic expectations of the benefits and risks, and allow choices consistent with values for patients in most of the studies.

Physical Exercise

Holistic nursing has always advocated the need for an individualized healthcare delivery system and approach. Physical exercise (PE) is a nursing care modality that is optimally beneficial when individual characteristics are taken into consideration during a nursing intervention. This makes it easy to address individual differences that may exist among patients during the care plan process. A more personalized approach to exercise prescription improved training efficacy and consequently reduce physical training unresponsiveness (Weatherwax et al., 2018).

Comparing two different modes of exercise intensity using a threshold-based model (i.e., ventilatory threshold), 100% of people experience a positive change in maximal oxygen uptake (VO₂max) compared to only 41.7 percent when standard exercise intensity is prescribed using a relative percent method (Wolpert et al. 2015, by Weatherwax et al. (2018)). Participants were implored not to change their regular diet during the study period, and a nutritional log was obtained from them. At the end of the trial, 67% of the participants on individualized intervention were no longer considered to have MetS, while the case was 17% in those with standardized exercise prescriptions (Chiang et al., 2019).

The intervention allows patients and their families to make an online appointment to raise questions and obtain answers through a network platform provided by the hospital. Each patient was instructed to receive reminders about daily precautions and exercise on the internet on time. Nursing staff were arranged to post guidance on psychology, physiology, and blood glucose control on the internet. Among patients with gestational diabetes mellitus, the internet combined with exercise-based individualized nursing intervention decreased blood pressure, and blood lipid levels and, most crucially, it lowered high blood glucose levels and unfavourable pregnancy outcomes. It also improved patients' mental well-being and satisfaction with their nursing care (Chen et al., 2021).

Comparing the booklet versus the MetS app on indices such as body weight (primary outcome), the total amount of exercise, blood pressure, and lipid concentrations (Mi et al., 2021). Results indicated that the app effectively promoted regular aerobic physical exercise, such as brisk walking, leading to weight reduction within 3 months. MetS app may have further facilitated the self-monitoring of individual health and the recording of exercise, body weight, and waist circumference, thereby enhancing the participants' self-efficacy for adequate dietary control, exercise initiation, self-monitoring, and maintenance, leading to a greater amount of exercise and body weight reduction (Mi et al., 2021).

Diet and nutrition

A healthy diet combined with physical exercise has proven to be beneficial in preventing and managing MetS (Chiang et al., 2019). The IGOBE study geared toward improving diet habits among MetS patients, included a baseline visit, an intensive program of six weekly 1 h sessions, and two follow-up visits at 6 and 12 months. The nutritionists and nurses conducted the six weeklies 1 h sessions with 15 patients per group using the active-participation method, encouraging communication and interactive learning (Tejera et al., 2022).

The intervention adopted a structured program of nutrition education for obese patients based on group care. Promotes the consumption of a healthy diet, the performance of prescribed exercises, and the provision of behavioural support in a clinical real-life setting for adults with obesity (Tejera et al., 2022). The topics discussed during the sessions were the preparation of menus, healthy recipes, preparation of healthy eating plans, knowledge about labelling, methods of managing

emotional hunger, and registration of weekly activities (Tejera et al., 2022). This intervention program was especially effective in reducing abdominal obesity, a well-known risk factor for the development of MetS and its co-diseases (Tejera et al., 2022). Combining e-health education and nutritional modification demonstrated a decline in MetS prevalence after following a Mediterranean diet among study groups but was not associated with weight loss (Mi et al., 2021). Moreover, the reduction of MetS prevalence following the adoption of the Mediterranean diet among this study group is also indirectly related to a decreased risk of other associated complications, such as chronic kidney disease, fatty liver disease, all-cause mortality, and colonic diverticulosis.

Psychotherapy

Motivational interviews, as a counselling technique, has the potential to generate not just behavioural changes but also psychological adaptability in individuals. Depressive episodes were measured using Beck Depression Inventory, Medical Outcomes Short Form-36 Health Survey, and the International Physical Activity Questionnaire assessed outcome variables at baseline and 12 weeks after the intervention. With motivation and counselling as a nursing intervention tool, significant improvement was recorded in health-related quality of life (HRQL) in women with metabolic syndrome (Weatherwax et al., 2018).

When compared to method using booklet and pamphlets, women in the experimental group reduced the weekly sitting time by 374 minutes and showed lowered depressed symptoms. They had better HRQL overall. The women in the comparison group exhibited no change in sedentary habits compared to the experimental group, but they did have lower depression symptoms and no recorded improvement on certain HRQL subscales. To ensure greater impact, the study suggests that motivation and counselling should be individually tailored with weekly phone calls lasting 15-30 minutes. This is because they might be more memorable to the patients and appear more credible than when non-tailored communication is deployed (Hu et al., 2021; Mi et al., 2021)

Medication

Different medications and combinations of medications are prescribed and administered by doctors and medical practitioners for people living with MetS daily in a hospital setting. Depending on the

number and combination of comorbidities presented by the client, oral, subcutaneous intramuscular medications are prescribed. For patients with diabetes mellitus, insulin therapy and oral antidiabetic drugs (OADs) are the primary care options. For patients with Type2 diabetes (T2DM) who have suboptimal glycaemic control and show no response to OADs, basal insulin (BI) is one of the first choices for glucose treatment. Timely insulin initiation and adequate titration of the insulin dose by either physicians or patients are essential steps to achieving and maintaining treatment goals (Hu et al., 2021). The situation of delayed insulin initiation and suboptimal dose titration could be attributed to limited healthcare resources and clinical inertia among both patients and clinicians and results in poor glycaemic control. It was reported that while >75% of healthcare professionals discussed titration at the initiation visit, only 16% to 28% of patients remembered such discussions (Hu et al., 2021).

The role of nurses with medication apart from sharing and dispensing the dosage prescribed by the doctors could also include If necessary, urging the patients to take drugs according to the doctor's advice and calling back the patients to understand their basic situation and provide corresponding guidance based on the doctor's recommendation and the health conditions of the client. Antihypertensive drugs were the most common medication among MetS patients. As regards the treatment for lower cholesterol and the rate of medication use, statins were the most frequent medication (28.3%in CG and 30.8% in IG). On the contrary, the rate of fibrate consumption was less common. The use of hypoglycaemic agents, insulin, and DPP-4 inhibitor was common among patients; the mean number of medications consumed was 1.7 medications/patient (Tejera et al., 2022). Metabolic syndrome is also increasingly being observed in patients under treatment with second-generation antipsychotics (SGA). These medications support the genetic and environmental factors that contribute to the development of MetS among people living with schizophrenia. Mental health nurses must pay attention to their clients' symptoms as they could be pointers to MetS. Nurses can provide health education to these clients concerning these possibilities as increased awareness could prevent its development or ensure early detection (Chiang et al., 2019).

Conventional intervention

Since patients' characteristics and needs may differ greatly during care, nurses adopt different modalities of nursing care procedures during the intervention to achieve nursing care goals and objectives. The mode or tools adopted for a nursing care procedure are influenced by many factors

including, hospital guidelines, standard care practice, nurse's experience level, attitude to work, and philosophy of care.

Specifically, the nursing staff are arranged to pay close attention to the patient's MetS symptoms such as blood glucose, blood pressure levels, blood lipid profile and body weight. They inform the patients and their families of daily precautions such as diet adjustment and moderate exercise. If necessary, the staff was required to urge the patients to take drugs according to the doctor's advice and call back the patients to understand their basic situation and provide corresponding guidance according to their condition.

Non-conventional intervention

Seeing there is no consensus on the standard nursing intervention for metabolic syndrome. Non-conventional nursing interventions explore different care options, their applications, and the results. While in most of the studies, the conventional intervention mode of nursing education uses verbal, booklet, or telephone calls. Non-conventional nursing interventions identified from selected studies and trials use distinct and innovative approach depending on the patient population status. Innovative health education approach combines motivation and counselling, internet combined with exercise-based individualized nursing intervention, and lifestyle interventions, which include the use of its mobile application, IGOBE, and individualized exercise prescription. These nursing interventions applied to various groups of patients diagnosed with MetS or at significant risk and reported improve patient outcomes.

Nursing staff are arranged to develop an actionable plan for each patient. They adopt different modes to ensure the autonomy of patients in terms of care responsibility. They put a mechanism in place that ensures easy and continuous access to care or consultation. The intervention considered various outcomes, such as body weight, physical exercise, cardiovascular endurance, cardio-metabolic risk factors, and psychological outcomes using a perceived stress scale and exercises self-efficacy. Comparing the outcome of the two intervention approaches that is convention and non-conventional nursing intervention. There are distinct choices of nursing care modes and subsequently there are significant differences in the outcome and impact of care on the patients. The innovative, holistic care and interdisciplinary approach adopted by non-conventional care produce more favourable outcome and ensure significant improvement in the general health and

wellbeing of patient as well as patient satisfaction with the standard of care received. The table 7 below show the different modalities and differences in approach to nursing care between conventional and non-conventional nursing. The table highlighted the outcome of the care intervention.

Table 7 Differences between conventional and non-conventional nursing intervention

Indicators	Conventional	Non-conventional
Change in HbA1c	Suboptimal dose titration, fear of hypoglycemia, Irregular monitoring.	Optimal insulin dose titration reduced the level of glycated hemoglobin. Enhanced monitoring plan
Fasting plasma glucose	Poor monitoring, and discontinuation of treatment.	Improved monitoring habits. Adherence to the treatment plan
Body weight Abdominal obesity Total body weight loses	No significant effect on total body weight and visceral fat.	Reduced body weight and a significant reduction in abdominal fat
Physical activity level	Low non-adherence to routine and exercise plan	Improved physical activity level. Improved compliance to exercise routine
Psychosocial status Anxiety Depression	Fear and apprehension due to lack of knowledge. Depressive episodes due to lack of support system.	Reduced anxiety and depression due to appropriate health education content and media for connection support service.
Blood lipid level Triglyceridemic	Fluctuating blood lipid level	Marked reduced level of blood lipid with appropriate diet and exercise habits.
Blood cholesterol level Low-density lipoprotein High-density lipoprotein	Reduced high-density lipoprotein, increased low lipid lipoprotein	Increased high-density lipoprotein and reduced low-density lipoprotein.
Behavioral changes Eating habit Sitting time	Inconsistent healthy eating habits. Long sitting hours watching tv or using a phone	Mediterranean diet, predominantly fruits, and a plant-based diet. Reduce sedentary habits.
Other indicators Smoking habit Foot care	Reduced smoking Irregular care or no care at all	Quite or significant reduction in smoking habits. Included in daily routine. Regular care and monitoring

6 Discussion

Patient-oriented care is the current gold standard in healthcare delivery as it essentially addresses each patient as an individual and holistically addresses their health problems (Locke et al., 2015;

Paley & Johnson, 2018). Client-centred care takes a patient 'as a whole and treats him or her holistically; also allows him or her to have a choice or contribution in his or her process of care. In another word, it encourages autonomy in health care and social service. In holistic care, a care plan is based on patient-centred needs. The care plan is realistic, structured, and well-defined. Some of the key elements of client-centred care include the principle of equality, autonomy, self-efficacy, self-management, empowerment, motivation, and sense of capabilities.

Nursing education as a nursing intervention tool or modalities of lifestyle intervention for MetS management may include educational programs comprising educational sessions, on-site exercise supervision, and home-based lifestyle interventions. Only booklet and follow-up advice over the telephone have not proven sufficient to combat discontinuation and poor adherence to treatment. The major challenge of these modalities is the difficulty in keeping up with the patient's activities and updating the treatment plan or goal continuously as the need or health condition of patients changes.

The educational content covered the knowledge related to metabolic syndrome, risk factors and its medical care, and the importance of lifestyle modification such as exercise, proper diet, quitting smoking, and stress management. The alert and reminder functions of the app encouraged the participants to maintain their exercise habits. Though not to the level of statistical significance, the triglyceride concentrations and systolic blood pressure were lower in the app group than in the booklet group. The app effectively promoted regular aerobic physical exercise, such as brisk walking, leading to weight reduction within 3 months (Mi et al., 2021). The goal was to investigate the effect of a home-based interactive e-health educational intervention program for young-old clients with MetS, using either an app or a booklet to support their lifestyle modifications. With the popularity and access to the internet in today's world, nursing intervention would do well to benefit and make use of the media in delivering care. Internet and mobile nursing are new and innovative ways to meet patient care needs.

Physical activities interestingly improve the status of all component diseases of MetS; reduces bad fat, enhance insulin sensitivity, reduce body weight, and promote blood circulation. This also reemphasized that, nursing education relating to MetS management should target weight control, increased physical activity, promote alcohol moderation, and sodium restriction; and increased consumption of fresh fruits, vegetables, and low-fat dairy products (Xiong et al., 2020). In actual

daily life, the nursing staff is unlikely to accompany patients to guide them on day-to-day physical activities program all the time. Therefore, real-time guidance to patients has become one of the keys to the prognosis of gestational diabetes mellitus (GDM). The conventional mode of exercise prescription on paper or brochure has proven ineffective. Adopting emerging technology, the internet, and mobile application makes regular and continuous access to a patient for a care guide and instruction possible. The implementation of internet-based nursing intervention effectively addresses this situation in the research study of (Weatherwax et al., 2018).

Most of the reviewed studies are geared toward lifestyle modification in which dietary and nutritional habit is a big part. The interventions summarily always encouraged patients to change their unhealthy lifestyle, adhere to the prescribed and ensure weight and body composition control. This stems from the understanding that healthy nutritional habits and regular moderate exercise can increase insulin sensitivity, reduce blood pressure, improve HDL (good cholesterol) levels, and reduce other cardiovascular risk factors. (Kim et al. 2022). In the usual practice, after basal evaluation, the doctors and nurses provided a written prescription of the recommended diet and exercise (4). However, it has been established that poor adherence to health practitioners' care intervention and prescription is a major challenge with MetS patients (Fernández-Ruiz et al., 2018). Most non-conventional nursing interventions followed a structured program of habit change.

Client-centred care can be promoted through dialogue using Open questioning, Affirming, Reflecting, and Summarizing OARs approach in the motivational interview (Miller, W. R., & Rollnick, S. 2013). This form of dialogue uses elements such as motivation, open-ended questions, empathizing active listening, and reflection. Rephrasing the patient's sentence for affirmation. It could be good for empathy and inciting thoughts of the patients and making summaries from the pool of information generated through the dialogue. This also helps the client to communicate what is in his or her mind rather than the nurse determining the client's opinion.

Stimulating patients to commence lifestyle modification and ensuring compliance is a challenge with conventional nursing care management (Jenum et al., 2019; Uusitupa et al., 2019; Kim et al. 2022). This challenge brings to the fore the role of nurses and nursing intervention in ensuring and maintaining healthy lifestyle practices among clients with Mets. As people shift from reading print to gadgets, the use of the MetS app and the positive findings (compared with the booklet group) underscores the need for more technological modalities in patient management. The use of

smartphones proved significant in reducing BMI and improving commitment to physical exercise while offering optimal health records (Porca et al. 2021). The biopsychosocial model of healthcare ensures every aspect of the patient is catered to and considered essential. Unfortunately, the system is less likely to look out for psychosocial complications of diseases, which could worsen patient outcomes despite other forms of care. Therefore, nursing interventions should also be geared towards boosting the morale of people living with MetS to keep them motivated enough to comply with their line of management and improve health-related quality of life. (Ford and Li, 2008). It is also applicable and useful in smoking cessation, management of diabetes, and alcohol problems. (Chiang et al. 2019).

In the management of MS, unidirectional therapies (i.e., those based on a unique intervention, such as diet, exercise, and education) have achieved unsatisfactory results, and the benefits of such therapies have not been maintained over time (Fernández-Ruiz et al., 2018). Despite proposed effective treatment modalities to reverse the trajectory of MetS people with MetS continue to experience negative mood states (i.e., depressive symptoms) and poor health-related quality of life. Therefore, it is important to implement strategies that improve psychological health and HRQL for this population (Chiang et al., 2019). However, when investigating changes in cardiometabolic risk factors (i.e., changes in MetS factors), it has been established that the exercise intervention as well as the lifestyle outside of the exercise intervention play a critical role in the changes in MetS factors. For example, dietary intake, sedentary behaviour, sitting for prolonged periods, sleep duration, and chronic stress have all been linked to influencing components of MetS syndrome (Weatherwax et al., 2018). Active lifestyles contribute to better HRQL and fewer depressive symptoms. Unfortunately, most people with MetS, particularly middle-aged and older women, do not consistently adhere to the recommended guidelines for modifying their lifestyles and tend to maintain sedentary lifestyles (Chiang et al., 2019). However, the results of previous studies have shown considerable individual variability in responses to a specific dose of standardized exercise, including the so-termed responders, non-responders, and, in some cases, adverse responders (Weatherwax et al., 2018)

Because patients attend individual, in-person clinical visits with a limited time, lack personalized therapy, are living in an environment with a high prevalence of obesity, and have comorbidities. Group visits to support behaviour change among obese individuals are an effective alternative to individual visits to promote changes in unhealthy diets and increase the level of physical exercise

(Tejera et al., 2022). Many studies have shown that most patients usually feel fear, rebellion, and conflict with the medical staff because of the pain caused by the disease and the lack of knowledge related to the disease (Chen et al., 2021). A disconnect exists between doctors' and patients' perceived barriers to effective BI titration, only patient-led initiation and titration of basal insulin without help from the nurse seemed not enough for glucose control (Hu et al., 2021). Therefore, an interdisciplinary approach where different therapies and professionals come together is required. This type of approach has shown a significant reduction in the overall prevalence.

Suboptimal glucose control in T2DM is very prevalent and associated with the progression of diabetic complications. (Sobngwi et al. 2012). A nurse-led decision support intervention for basal insulin self-titration proves efficacious and safe in T2DM. This intervention is supported using telephone coaching to offer regular guidance, monitoring, and adjusting insulin doses as appropriate. This considerably ensures tighter glucose control as evidenced by a reduction in HbA1c and other glycaemic marker levels. The intervention also improves knowledge of diabetes among participants which further helps to prevent complications. (Liu et al. 2018). The I2AO2 intervention further improved cardiovascular parameters, blood glucose levels, and HbA1c compared to the control group and can be a helpful intervention for people with T2DM (Fernández-Ruiz et al., 2018).

6.1 Limitations of study

The study focused on nurse led intervention for people living with MetS mostly within the hospital setting. The search term therefore automatically filters out other intervention for people living with MetS that are conducted other health professionals. The search term only accommodate publication in English. The year of publication for included article was limited to ten years from date of publication until present. During the process of abstract reading, article that does not directly answers the research question were also eliminated regardless of other relevance. The ages of participants were also considered during the final selection of article for analysis to ensure homogeneity in population and ease of generalization of findings outcome.

6.2 Ethical consideration

Ethics form the basis for the protection of the subject in research and scientific studies. As members of the scientific community, nurse researchers have the obligation to identify and applying distinct ethical criteria that protect animate subject and that have profound reverence for human being and

their experiences (Munhall et al., 1988; Pietilä et al., 2020)). The basic ethical ethos of autonomy, non-maleficence, beneficence, and justice is the watchword of any responsible research based on sound ethical standards (Pietilä et al., 2020). Though this study being a literature review that relied heavily on data from previously conducted studies. The research papers selected for analyses were examined for ethical principle and respect of participants' rights. All were screened by the ethical board of their various institutions and got ethical approval in accordance with the statement of ethical principle of the Declaration of Helsinki (Rumbold & Pierscionek, 2017). The specific guideline pertaining to this review in accordance with the Jyväskylä University of Applied Science was fully respected. There was not any conflict of interest or external influence due to financial gain or other benefit because of conducting this study. The table of critical appraisal of the selected studies for this review is presented in the appendix 2.

6.3 Validity and reliability

No new data was gathered for the purpose of this study. The current work relied on data from studies selected for analysis. It reported the perceived outcome of the health and wellbeing of people living with MetS having participated in a nurse-led nursing intervention for metabolic disease treatment in a hospital setting. The validity and reliability of this study rest on the sources (databases) of the research articles and the quality of methodology adopted by the research. The number of participants in the studies, the research plans, novelty, and the relevance of the outcome to the studies to the general body of knowledge based on the quality of journal that feature the article. Regarding the responsibility of the study to ensure validity and reliability. The papers were properly screened via relevant inclusion and exclusion criteria. The sources of the selected articles are reliable and established databases and journals known for quality research and verifiable scientific methodology.

7 Conclusion and recommendations

Non-conventional nursing intervention modalities of lifestyle intervention for MetS management that include educational programs comprising a range of mobile apps and internet-based educational sessions would enhance patient knowledge and foster empowerment. Patient empowerment promotes self-care and the development of an innate capacity for responsibility through education and motivation by healthcare professionals. Health-related decision aids

improve knowledge of treatment options, provides realistic expectations of the benefits and risks, and allow choices consistent with values. All the above activities were under the philosophy of empowering the patient for change, respecting the patient's autonomy, and creating a healthcare professional-patient relationship of respect, empathy, and accompaniment for change (Fernández-Ruiz et al., 2018).

A well-tailored nursing intervention offers ongoing encouragement, guidance, and determination of relevant sources of decisional conflict, facilitating healthy adjustment and improving client wellbeing. Non-conventional nursing intervention could be an effective model for community-based approaches to promote health among middle-aged and older women with other chronic health conditions including obesity, type 2 diabetes, and cardiovascular disease (Chiang et al., 2019). Group visits for persons with obesity could provide opportunities for peer support (Tejera et al., 2022). The MetS app may be incorporated into the health promotion program to support exercise maintenance and a healthy lifestyle in the community (Mi et al., 2021).

Knowledge and awareness of nurses about relevant nursing interventions are crucial to the nursing goals and general outcome. Knowledge and awareness provide new options and ideas for various health institutions and nursing departments to improve their standard of management. This literature review has provided insight into possible interventions and how they can be tailored to each population group. Various institutions and nursing departments should actively work on developing a line of management that incorporates some of these interventions as appropriate for their setting. There should also be an increase in awareness about metabolic syndrome among nurses and patients. Future studies should consider more high-risk groups, as well as the applicability of similar nurse-led interventions in low-resource settings.

Medication and drug therapy are mostly the responsibility of a medical doctor for a prescription (Soliman, 2020). Dispensation on the part of nurses should be timely and regular as planned. Indication and side effects of the administered medicine are also essential (Hall et al., 2006; Soliman, 2020). Measurement of vital signs such as body weight, height, BMI, blood pressure, respiratory rate, and heart rate, body temperature at every visit or check-up (Grundy et al., 2005). Relevant clinical tests would depend on the risk factors identified via the diagnoses (Poljičanin et al., 2012b; Soliman, 2020). Electrocardiogram; Urinalysis; Fasting blood glucose; Hematocrit; Serum potassium; Creatinine (or the corresponding estimated glomerular filtration rate); Calcium; and Lipid profile

(after a 9- to 12-hour fast) that includes HDL-C, LDL-C, and triglycerides (Hall et al., 2006; Kaur, 2014; Poljičanin et al., 2012b; Soliman, 2020).

Lifestyle change is key to the management of Mets combined with available medical help. Physical activity and exercise are key components of energy metabolism. There are different modes of follow-up these days. Because MetS patients need regular checks and assistance, nurses need to devise adequate mediums for continuous and regular communication with their patients. The benefit from a healthy lifestyle goes beyond the management of MetS alone but also enhances general well-being and prevention of other deadly diseases. An adequate monitoring system would help to prevent or reduce adverse episodes, undue complications, and emergencies (Hall et al., 2006; Jenum et al., 2019; Spencer et al., 2015; Uusitupa et al., 2019).

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Appendexes

Appendix 1 Article selected for data extraction and analysis

s/n	Title of the research article	Author	Date	Research method
1	Efficacy and Safety of a Decision Support Intervention for Basal Insulin Self-Titration Assisted by the Nurse in Outpatients with T2DM: A Randomized Controlled Trial	Hu X, Deng H, Zhang Y, Guo X, Cai M, Ling C, & Li K.	2021	Randomized control trial / Qualitative analysis
2	Effect of the internet combined with exercise-based individualized nursing intervention in patients with gestational diabetes mellitus	Chen, Y., Qiu, C., Chen, J. et al.	2021	Randomized control trial / Qualitative analysis
3	The Effect of a Lifestyle Intervention Program Using a Mobile Application for Adults with Metabolic Syndrome, versus the Effect of a Program Using a Booklet: A Pilot Randomized Controlled Trial	Wong EML, Leung DY, Tam HL, Wang Q, Yeung KW, & Leung.	2021	Randomized control trial / Qualitative analysis
4	Reducing Metabolic Syndrome through a Group Educational Intervention Program in Adults with Obesity: IGOBE Program	Tejera C, Porca C, Rodriguez-Carnero G, Andújar P, Casanueva FF, Bellido D, Crujeiras AB.	2022	Randomized control trial / Qualitative analysis
5	Changes in Metabolic Syndrome Severity Following Individualized Versus Standardized Exercise Prescription: A Feasibility Study	Weatherwax, R. M., Ramos, J. S., Harris, N. K., Kilding, A. E., & Dalleck, L. C.	2018	Qualitative analysis
6	Motivational Counseling to Reduce Sedentary Behaviors and Depressive Symptoms and Improve Health-Related Quality of Life Among Women with Metabolic Syndrome	Chiang, L. C., Heitkemper, M. M., Chiang, S. L., Tzeng, W. C., Lee, M. S., Hung, Y. J., & Lin, C. H.	2019	Qualitative analysis
7	Effectiveness of the I2AO2 interdisciplinary program led by nurses on metabolic syndrome and cardiovascular risk: a randomized, controlled trial	Fernández-Ruiz VE, Paniagua-Urbano JA, Solé-Agustí M, Ruiz-Sánchez A, Gómez-	2018	Randomized control trial /

		Marín J, Armero-Barranco D.		Qualitative analysis
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Appendix 2 **Reviewed article critical Appraisal (Hawker et al, 2002)**

Author and country of study	1 Abstract/ title	2 Introduction and aims	3 Methods and data	4 Sampling	5 Data analysis	6 Ethics and bias	7 Results	8 Transferability or generalizability	9 Implications and usefulness	Total
Hu X, Deng H, Zhang Y, Guo X, Cai M, Ling C, & Li K. 2021	4	4	4	3	4	4	4	4	3	34
Chen, Y., Qiu, C., Chen, J. et al. 2021 (China)	4	4	4	4	4	4	4	4	4	36
Wong EML, Leung DY, Tam HL, Wang Q, Yeung KW, & Leung. 2021 (China)	4	4	4	3	4	4	4	4	3	34
Tejera C, Porca C, Rodríguez-Carnero G, Andújar P, Casanueva FF, Bellido D, Crujeiras AB. 2022.	4	4	4	3	4	4	4	4	4	35

(Spain)										
Weatherwax, R. M., Ramos, J. S., Harris, N. K., Kilding, A. E., & Dalleck, L. C. (2018). (New Zealand)	4	4	4	4	4	4	4	3	3	34
Chiang, L. C., Heitkemper, M. M., Chiang, S. L., Tzeng, W. C., Lee, M. S., Hung, Y. J., & Lin, C. H. (2019). (Taiwan)	4	4	4	3	4	4	4	3	3	33
Fernández-Ruiz VE, Paniagua-Urbano JA, Solé-Agustí M, Ruiz-Sánchez A, Gómez-Marín J, Armero-Barranco D. (2018) (Spain)	4	4	4	3	4	4	4	4	3	33

Appendix 3 Summary of Review Articles

Author and country of study	Study	Study objectives	Methodology: design, data collection, and analysis	Main Study findings	Critical appraisal (Hawker et al. 2002)
Hu X, Deng H, Zhang Y, Guo X, Cai M, Ling C, & Li K. 2021 (China)	Efficacy and Safety of a Decision Support Intervention for Basal Insulin Self-Titration Assisted by the Nurse in Outpatients with T2DM: A Randomized Controlled Trial	The study objective was to evaluate a combined fasting blood glucose-based dosage self-titration setting and decision-supported telephone-coaching intervention on glycaemic control and diabetes self-management skills, compared to conventional care.	12-week, single-blinded, randomized controlled trial was conducted on adults with type 2 diabetes (T2DM) primarily treated with basal insulin. After randomization, the intervention group (IG, n = 426) received a basal insulin self-titration decision support intervention administered by the Diabetes Specialty Nurses while the control group (CG, n = 423) received conventional care for 12 weeks, both included five telephone interviews.	The IG showed more improvements on mean HbA1c, compared to the CG (-2.8% vs -1.8%), and so did the FPG, PPG, MDKT, DES-DSF and SDSCA (all P<0.01) after the 12-week follow up. Though the final mean insulin dose in the IG was higher than the CG at the end of the study (0.32 U/kg vs 0.28 U/kg), the changes in body weight were similar between the two groups (0.46kg vs 0.40kg, P=0.246), and the proportion of patients with hypoglycemia events during the whole trial was similar (20.65% vs 17.73%, P=0.279)	34
Chen, Y., Qiu, C., Chen, J. et al. 2021 (China)	Effect of the internet combined with exercise-based individualized	This study aimed to determine the clinical efficacy of the internet combined with	In total, 139 patients with GDM were divided into two groups, with 79 patients in the observation group (internet combined with exercise-based	Compared with the control group, the following indices of the observation group were lowered: blood glucose-related indices (FBG and 2 h PG), blood	36

	nursing intervention in patients with gestational diabetes mellitus	exercise-based individualized nursing intervention in patients with gestational diabetes mellitus (GDM).	individualized nursing intervention) and 60 patients in the control group (routine nursing intervention only). The two groups were given specified nursing intervention for 8 weeks and then compared for changes in their blood glucose, blood lipids, blood pressure, insulin resistance (IR), and rate of adverse pregnancy outcomes. Additionally, the psychological state was analyzed, and their nursing satisfaction with the care from nurses that they received was investigated before and after the nursing intervention.	lipids and blood pressure associated indices (TG, TC, and HbA1c, DBP, SBP, and MAP), and IR-related indices (FINS, 2 h INS, and HOMA -IR) (all $P < 0.05$). The observation group also showed a lower rate of adverse pregnancy outcomes than the control group (7.59% vs. 20.00%; $P < 0.05$). In addition, SAS and SDS scores of the observation group were both lower than the control group ($P < 0.05$).	
Wong EML, Leung DY, Tam HL, Wang Q, Yeung KW, & Leung. 2021 (China)	The Effect of a Lifestyle Intervention Program Using a Mobile Application for Adults with Metabolic Syndrome, versus the Effect of a Program Using a Booklet: A Pilot Randomized Controlled Trial	This study was designed to examine the effects of motivational interviews, dietary advice, and physical activity on the incidence and symptoms of preeclampsia in pregnant women with MetS.	This randomized, single-blind, controlled clinical trial was performed in two hospitals. compared the use of a MetS mobile app versus the use of an educational booklet recruited 77 participants from two community centres. To investigate the impact of a LIP on different outcomes for adults with MetS in the community, the participants were randomized into the MetS app group (App Group) and booklet group as control.	Within three months, the app group had a substantial drop in body weight (-1.069, $p = 0.012$) and BMI (-0.371, $p = 0.026$), more physical activity (= 8.454, $p = 0.032$), and increased exercise self-efficacy (= 10.62, $p = 0.001$). Other outcomes showed no significant differences between groups. The participants in the app group found the MetS app helpful and appreciated by the participant.	34

<p>Tejera C, Porca C, Rodriguez -Carnero G, Andújar P, Casanueva FF, Bellido D, Crujeiras AB. 2022. (Spain)</p>	<p>Reducing Metabolic Syndrome through a Group Educational Intervention Program in Adults with Obesity: IGOBE Program</p>	<p>This study aimed to investigate the effectiveness of an intensive lifestyle program in reducing the prevalence of MetS in adults with obesity.</p>	<p>Patients with obesity (n = 456, 48.8 ± 12.8 years, 18.5% male) were randomized in two groups as indicated in a prospective interventional real-life study: a control group (CG), in which patients received usual care, and an interventional group (IG), in which the patients participate in a healthy lifestyle habits program in six weekly sessions, IGOBE program. Anthropometric, body composition, medications, and MetS features data were analysed in both groups at the preintervention and post-intervention stages using a completer's analysis.</p>	<p>At 12 months of follow-up, the IG showed a relative reduction of 13.4% in the prevalence of MetS from baseline, while the CG showed a reduction of 2.1% (p < 0.001). A significant reduction was also observed in four of five MetS features. In this trial, implementation of the IGOBE program resulted in a significant reduction in MetS prevalence and better control of MetS features compared with the standard of care.</p>	<p>35</p>
<p>Weatherwax, R. M., Ramos, J. S., Harris, N. K., Kilding, A. E., & Dalleck, L. C. (2018). (New Zealand)</p>	<p>Changes in Metabolic Syndrome Severity Following Individualized Versus Standardized Exercise Prescription: A Feasibility Study</p>	<p>This study sought to investigate the efficacy of standardized versus individualized exercise intensity prescription on metabolic syndrome (MetS) severity following a 12-week exercise intervention.</p>	<p>A total of 38 experimental participants (47.8 ± 12.2 yr, 170.7 ± 8.0 cm, 82.6 ± 18.7 kg, 26.9 ± 6.7 mL · kg⁻¹ · min⁻¹) were randomized to one of two exercise interventions (exercise intensity prescribed using heart rate reserve or ventilator threshold).</p>	<p>Following the 12-week intervention, MetSz-score was significantly improved for the standardized (-2.0 ± 3.1 to -2.8 ± 2.8 [p = 0.01] and individualized (-3.3 ± 2.3 to -3.9 ± 2.2 [p = 0.04]) groups. When separating participants based on prevalence of MetS at baseline and MetS z-score responsiveness, there were six and three participants in the standardized and individualized</p>	<p>34</p>

				groups, respectively, with three or more MetS risk factors. Of the six participants in the standardized group, 83% (5/6) of the participants were considered responders, whereas 100% (3/3) of the individualized participants were responders. Furthermore, only 17% (1/6) of the participants with MetS at baseline in the standardized group no longer had symptoms of MetS following the intervention. In the individualized group, 67% (2/3) of participants with baseline MetS were not considered to have MetS at week 12.	
Chiang, L. C., Heitkemper, M. M., Chiang, S. L., Tzeng, W. C., Lee, M. S., Hung, Y. J., & Lin, C. H. (2019). (Taiwan)	Motivational Counselling to Reduce Sedentary Behaviours and Depressive Symptoms and Improve Health-Related Quality of Life Among Women with Metabolic Syndrome	The aim of this study was to evaluate whether a 12-week motivational counselling program reduces sedentary behaviours and depressive symptoms and improves HRQL in Taiwanese women	A randomized controlled study was conducted. Participants (n 115) were randomly assigned into 3 groups; experimental group (received a brochure on lifestyle modification combined with 12 weeks of motivational counselling), comparison group (received a lifestyle modification brochure), and usual care group (UCG). Outcome variables were measured at baseline and at 12 weeks post intervention by the International Physical Activity Questionnaire, Beck Depression	Women in the experimental group not only reduced (p<.001) weekly sitting time by 374 minutes but also decreased (p<.05) depressive symptoms, as well as had greater overall HRQL including 8 subscales as compared with the UCG. As compared with the UCG, the women in the comparison group had no change in sedentary behaviours, but they had reduced depressive symptoms and improvement on some HRQL subscales.	33

			Inventory, and Medical Outcomes Short Form-36 Health Survey. Generalized estimating equations were applied to analyse the intervention effects of groups by interaction of group and time.		
Fernández-Ruiz VE, Paniagua-Urbano JA, Solé-Agustí M, Ruiz-Sánchez A, Gómez-Marín J, Armero-Barranco D. (2018) (Spain)	Effectiveness of the I2AO2 interdisciplinary programme led by nurses on metabolic syndrome and cardiovascular risk: a randomized, controlled trial "	To evaluate the effectiveness of an interdisciplinary programme led by nurses in relation to metabolic syndrome (MS) and cardiovascular risk (CVR)	This randomized, controlled, clinical trial included 74 patients diagnosed with MS (experimental group [EG], n¼37; control group [CG], n¼37). The intervention consisted of a 12-month interdisciplinary programme (pre-test, 6 months of intervention, 12 months of intervention, and 1-year follow-up post-intervention) coordinated by nursing.	We found a progressive and significant reduction for all clinical, biochemical, and anthropometric parameters analysed at different time points. In the EG, remission of MS by 48.1% in the short term was observed (83.8% in the medium term) and maintained at 1-year post-intervention. In the CG, the prevalence of MS increased by 2.7% from the initial evaluation to study completion. A similar trend was observed for CVR. In the EG, 100% of subjects had a moderate-low risk of CVR at 1-year post-intervention, whereas the CG had CVR in all categories.	33

Appendix 4 Description of the main concepts

Main concept	Description
Conventional care	Specifically, the nursing staff are arranged to pay close attention to the patient's blood glucose and blood pressure levels and inform the patients and their families of daily precautions such as diet adjustment and moderate exercise. If necessary, the staff was required to urge the patients to take drugs according to the doctor's advice and call back the patients to understand their basic situation and provide corresponding guidance according to their condition.
Non-conventional care	Nursing staff are arranged to develop an actionable plan for each patient. They adopt different modes to ensure the autonomy of patients in terms of care responsibility. They put a mechanism in place that ensures easy and continuous access to care or consultation.
Nursing care mode	The nursing process consists of five steps: assessment, diagnosis, planning, implementation, and evaluation. The approach, tools, or mechanisms adopted by nurses to achieve the processes involved in their intervention. Mode refers to media, outlets, tools, or techniques to achieve nursing aims and objectives.

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