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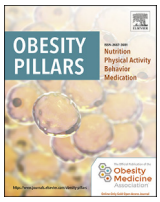

Obesity definition, diagnosis, bias, standard operating procedures (SOPs), and telehealth: An Obesity Medicine Association (OMA) Clinical Practice Statement (CPS) 2022

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ABSTRACT

Background: The Obesity Medicine Association (OMA) Clinical Practice Statement (CPS) regarding definition, diagnosis, bias, standard operating procedures (SOPs) and telehealth is intended to provide clinicians an overview of obesity medicine and provide basic organizational tools towards establishing, directing, managing, and maintaining an obesity medical practice.

Methods: This CPS is based upon published scientific citations, clinical perspectives of OMA authors, and peer review by Obesity Medicine Association leadership.

Results: OMA has defined obesity as: "A chronic, progressive, relapsing, and treatable multi-factorial, neurobehavioral disease, wherein an increase in body fat promotes adipose tissue dysfunction and abnormal fat mass physical forces, resulting in adverse metabolic, biomechanical, and psychosocial health consequences." While body mass index may be sufficiently diagnostic for populations and many patients, accurate diagnosis of adiposity in an individual may require anthropometric assessments beyond body weight alone (e.g., waist circumference, percent body fat, and android/visceral fat). Obesity complications can be categorized as "sick fat disease" (adiposopathy) and/or "fat mass disease." Obesity complications predominantly of fat mass origins include sleep apnea and orthopedic conditions. Obesity complications due to adiposopathic endocrinopathies and/or immunopathies include cardiovascular disease, cancer, elevated blood sugar, elevated blood pressure, dyslipidemia, fatty liver, and alterations in sex hormones in both males (i.e., hypogonadism) and females (i.e., polycystic ovary syndrome). Obesity treatment begins with proactive steps to avoid weight bias, including patient-appropriate language, office equipment, and supplies. To help manage obesity and its complications, this CPS provides a practical template for an obesity medicine practice, creation of standard operating procedures, and incorporation of the OMA "ADAPT" method in telehealth (Assessment, Diagnosis, Advice, Prognosis, and Treatment).

Conclusions: The OMA CPS regarding "Obesity Definition, Diagnosis, Bias, Standard Operating Procedures (SOPs), and Telehealth" is one in a series of OMA CPSs designed to assist clinicians care for patients with the disease of obesity.

1. Introduction

Beginning in 2013, the Obesity Medicine Association (OMA) created and maintained an online Adult "Obesity Algorithm" (i.e., educational slides and eBook) that underwent yearly updates by OMA authors and that was reviewed and approved by the OMA Board of Trustees [1]. This was followed by a similar Pediatric Obesity Algorithm, with updates approximately every two years by OMA authors. This current Clinical Practice Statement (CPS) is the first published version of the applicable chapters of the 2021 OMA Obesity Algorithm. To better provide the clinician reader with ready access to summarized, basic information, this CPS maintains many of the tables and figures found in the original OMA Adult Obesity Algorithm [1].

2. Definition

According to the Obesity Medicine Association, "Obesity is defined as a chronic, progressive, relapsing, and treatable multi-factorial,

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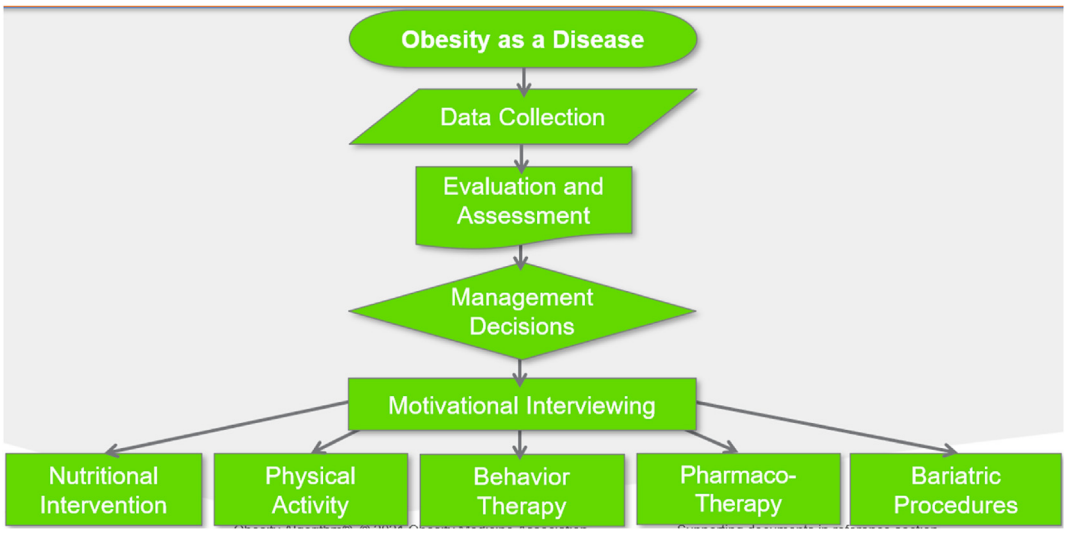

Fig. 1. Obesity Medicine Association Algorithm Overview of the Management of Obesity. Shown is the OMA overview of the management of obesity, starting with the treatment of obesity as a disease, collecting data, evaluating, assessing, making patient-centered management decisions, engaging in motivational interviewing, and implementing anti-obesity therapies (e.g., nutrition, physical activity, behavior modification, pharmacotherapy, and/or bariatric procedures).

neurobehavioral disease, wherein an increase in body fat promotes adipose tissue dysfunction and abnormal fat mass physical forces, resulting in adverse metabolic, biomechanical, and psychosocial health consequences" [1,2]. Fig. 1 provides an algorithmic overview of the management of obesity. Fig. 2 provides an overview of how obesity is a multifactorial disease. Fig. 3 describes the overall management goals for patients with obesity. Table 1 lists ten illustrative benefits of treating obesity as a disease.

3. Patient-centered approach

The adverse health consequences of increased body fat are not simply "co-morbidities" or "associated risk factors." Instead, obesity is a disease when [3,21]:

- The patient has excessive body fat as assessed by reliable measures.

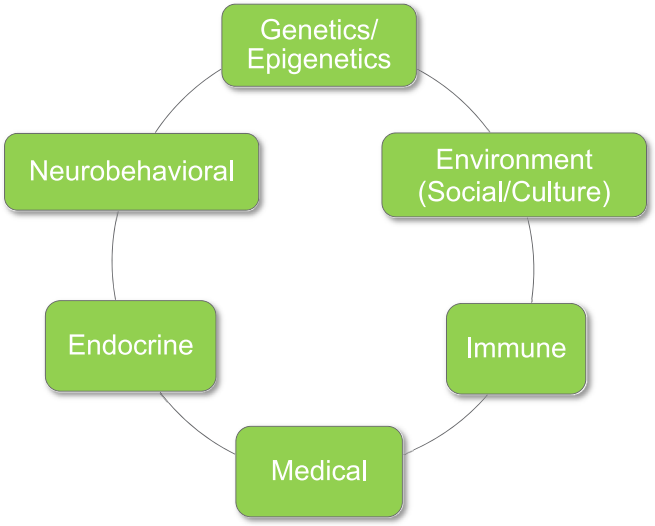

Fig. 2. Obesity Is a Multifactorial Disease. Obesity has many contributors that account for variations in individual presentations and variances in responses to interventions. Such contributing factors include genetics/epigenetics, environment, immune factors, medical factors, endocrine factors, and neurobehavioral factors [2–4].

- Excessive body fat is caused by genetic or developmental errors, infections or inflammation, hypothalamic injury, adverse reactions to medications, nutritional/energy imbalance, and/or unfavorable environmental factors.
- Excessive body fat results in pathogenic body tissue structural and functional abnormalities leading to increased patient morbidity and mortality.
- Multiple pathogenic adipocyte and/or adipose tissue endocrine and immune dysfunctions contribute to metabolic disease (adiposopathy or "sick fat disease").
- Multiple pathogenic physical forces from excessive body fat cause biomechanical stress damage to other body tissues ("fat mass disease").

Because obesity is a multifactorial disease with manifestations unique to the individual patient, its management and treatment require a multifaceted, patient-centered, individual approach ("one size does not fit all"). Diagnostic and therapeutic approaches derived from randomized clinical trial (RCT) data in populations may not always apply to an individual patient. Multiple contributors to obesity may account for RCT variances (sometimes wide variances) in individual assessment and therapeutic responses based upon age, race, sex, gender, genetics, individual physiology, socioeconomic status, nutrition, physical activity, concomitant medications, concurrent illnesses, and other challenges (i.e., physical or mental) [22,23]. Other factors that may influence obesity management include home environment (e.g., food access, stress, family, culture, school, travel); work environment (e.g., food access, stress, nature of work, wellness programs, travel) [24]; nutrition and physical activity environment; type of behavior modification [25]; utilization of motivational interviewing; use of "apps," text messages, and social media [25,26]; use of wearable technologies [27–31]; and treatment via anti-obesity medications and bariatric surgery. Variances in these patient-centered factors influence the optimal management plan for individuals with obesity and are factors to consider that go beyond reported mean value metrics of RCTs.

4. Prevalence of obesity

In 2017–2018, the prevalence of obesity was estimated to be approximately 42% in U.S. adults (20 years of age and older) [32], and in 2015–2016 it was approximately 18.5% in youths (2–19 years of age) [33]. According to a projection analysis conducted in 2019, approximately

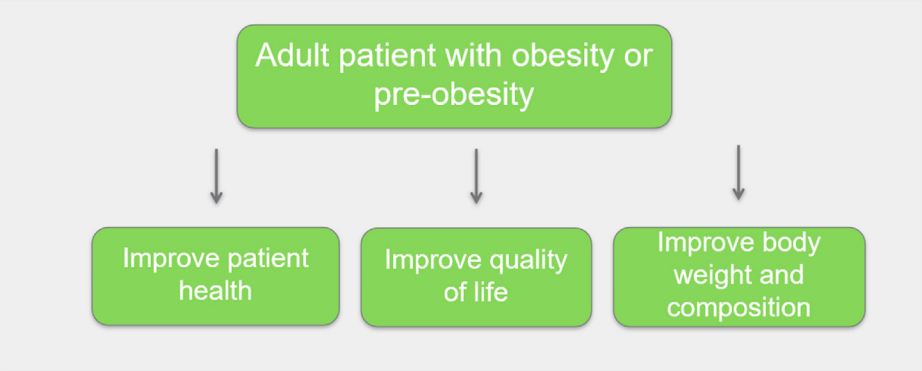

Fig. 3. Overall Management Goals for Patients with Obesity or Pre-obesity. For adults patients with obesity or pre-obesity, management goals include improvements in patient health, quality of life, body weight and body composition (i.e., fat mass and muscle mass). "Pre-obesity" is analogous to what is sometimes termed "overweight."

Table 1
Ten Illustrative Benefits of Treating Obesity as a Disease.

1.	Healthful nutrition (including negative caloric balance in patients with obesity) and regular physical activity often improve anatomic, physiologic, inflammatory, and metabolic body processes [5,6].
2.	Medically managed weight reduction in patients with obesity often improves glucose and lipid metabolism, reduces blood pressure, and reduces the risk of thrombosis [7].
3.	Medically supervised weight management programs for patients with obesity have the potential for statistically significant and clinically meaningful weight loss maintenance [8].
4.	Weight loss in patients with obesity may reduce premature all-cause mortality [9,10].
5.	Weight loss in patients with obesity may have favorable cardiac hemodynamic effects [5,11].
6.	Weight loss in patients with obesity may improve obstructive sleep apnea and osteoarthritis [12].
7.	Weight loss in patients with obesity may reduce the onset of certain cancers, improve response to cancer treatments, and reduce the onset/recurrence of new cancers [13].
8.	Weight loss in females with obesity may improve metabolism (polycystic ovary syndrome) as well as improve obesity-related gynecologic and obstetric disorders; weight loss in males with obesity may increase testosterone levels when hypogonadism is due to the adiposopathic consequences of obesity [14,15].
9.	Weight loss in patients with obesity may improve quality of life, improve body image, and improve symptoms of some psychiatric disorders (e.g., depression) [16–19].
10.	Weight loss in males and childbearing females with pre-obesity or obesity may help mitigate epigenetically transmitted increased risk of obesity and metabolic disease in future generations [20].

50% of U.S. adults will have obesity by 2030, with approximately 25% of adults having severe obesity [body mass index (BMI) greater than or equal to 35 kg/m^2] [34]. Non-Hispanic Black adults and Hispanic adults have a higher prevalence of obesity than non-Hispanic White adults. Non--Hispanic Asian adults have the lowest prevalence of obesity but also have lower BMI thresholds for adiposopathic complications [35]. At least since 1999, the trend towards an increase in prevalence in obesity continues to increase among adults and youth [33].

Data from the National Health and Nutrition Examination Survey (NHANES) 1999–2014 suggests greater than 35% obesity prevalence among those aged 40–65 in all U.S. regions (except the Mountain region, at 27%), with the highest prevalence being in the East North Central, West North Central, South Atlantic, East South Central, and West South Central regions of the U.S. [36]. Data from NHANES 1999–2014 further suggest the prevalence of metabolic syndrome is greater than or equal to 35% in the U.S. West North Central, West South Central, and East South Central regions (highest in the West North Central at 42% among those aged 40–65) and less than 30% in the Pacific, New England, and Mid--Atlantic regions [36]. Data from NHANES 2009–2016 suggests that only around 20% of U.S. adults have "optimal" metabolic metrics [37], defined as:

- Waist circumference <102 cm (40 inches) for males or < 88 cm (35 inches) for females
- Fasting glucose <100 mg/dL and hemoglobin A1c < 5.7%
- Systolic blood pressure <120 mmHg and diastolic blood pressure <80 mmHg
- Triglycerides <150 mg/dL

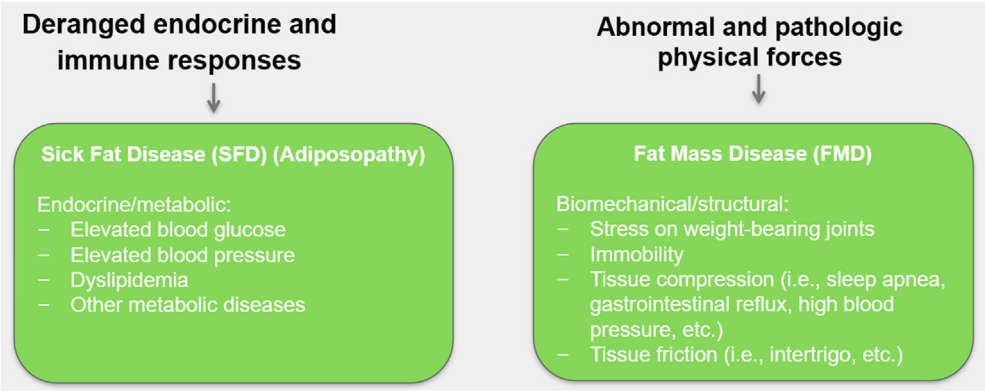

Fig. 4. Metabolic and Fat Mass Complications of Obesity. Obesity can have both metabolic and mechanical adverse consequences, including endocrine/metabolic consequences and pathogenic issues related to biomechanics [3,42–44].

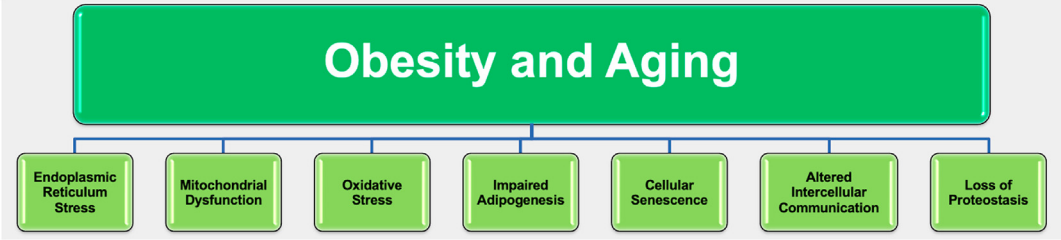

Fig. 5. Obesity Promotes Pathogenic Cellular Processes that Reflect Adiposopathic Aging. Obesity can promote similar degenerative cellular processes often associated with aging, including endoplasmic reticulum stress, mitochondrial dysfunction, oxidative stress, impaired adipogenesis, cellular senescence, altered intercellular communication, and loss of proteostasis [43,45].

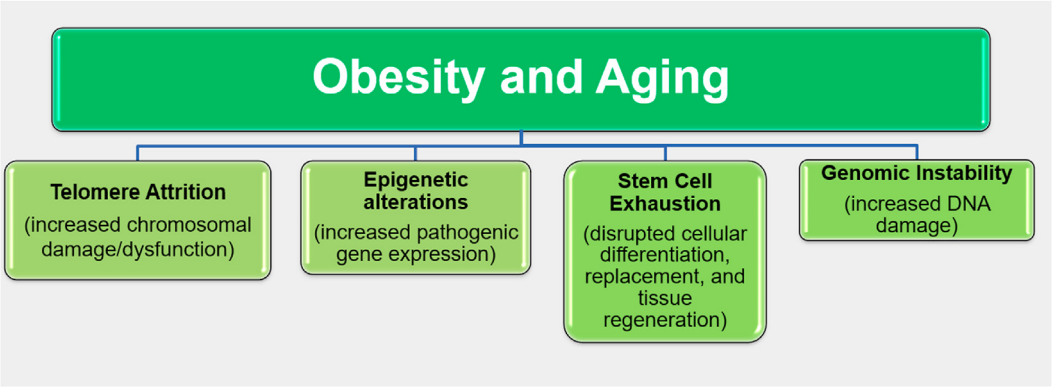

Fig. 6. Obesity promotes pathogenic genetic effects that reflect adiposopathic aging.

- High-density lipoprotein cholesterol ≥40 or 50 mg/dL for males and females, respectively
- Not taking any related medications for applicable metabolic diseases

5. People-first language

"People-first" language recognizes the preference of not identifying or labeling individuals by their disease. Thus, "patients with overweight or obesity" or "patients with pre-obesity or obesity" are preferred over "obese patient" [37,38]. This is similar to the standard with other diseases, such as diabetes mellitus, where "patient with diabetes" is preferred over "diabetic patient." Terms that are encouraged to avoid stigma and bias include [37,39]:

- Weight
- Unhealthy weight
- Overweight
- Pre-obesity
- Body mass index
- Excessive energy stores
- Affected by obesity

Terms discouraged and best avoided include [37,39]:

- Morbidly obese
- Obese
- Fat
- Heavy
- Large size

6. Obesity health care office equipment

A positive office space includes [40]:

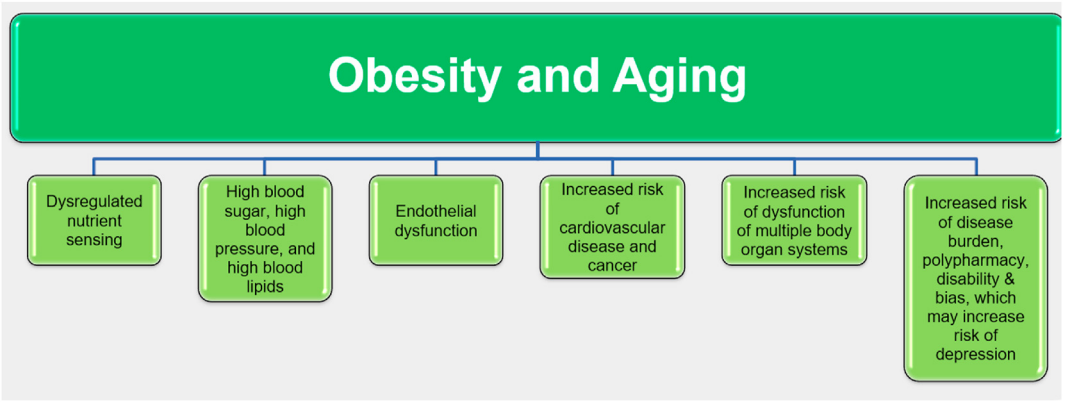

Fig. 7. Obesity promotes adverse clinical outcomes reflective of adiposopathic aging.

Table 2
Ten Takeaway Messages Regarding Obesity Classification and Consequences. Shown are takeaway messages regarding the classification and consequences of obesity.

1.	For the general population, body mass index (BMI) ≥ 25 kg/m^2 is considered overweight; BMI ≥30 kg/m^2 is considered obesity.
2.	BMI has limitations in assessing adiposity in individuals with increased or decreased muscle mass, males versus females, different races, and postmenopausal females.
3.	For individuals, accurately determining percent body fat, android fat, and visceral fat is a better assessment of the clinical implications of adiposity than BMI alone.
4.	Central obesity is defined as waist circumference ≥40 inches (102 cm) for males and ≥35 inches (88 cm) for females (≥90 cm for Asian males; ≥ 80 cm for Asian females).
5.	Waist circumference is directly correlated with the risk of metabolic and cardiovascular disease.
6.	Fat mass disease results in pathologic mechanical and physical forces leading to adverse clinical outcomes (e.g., sleep apnea, orthopedic problems).
7.	Sick fat disease (adiposopathy) results in pathologic endocrine and immune responses that promote the most common metabolic diseases encountered in clinical medical practice (e.g., diabetes mellitus, high blood pressure, dyslipidemia).
8.	Anatomic adiposopathic changes with obesity include adipocyte hypertrophy, adipose tissue expansion, increased energy storage in multiple fat depots, and increased fat deposition in body organs.
9.	Functional adiposopathic changes with obesity include adipose hypoxia, increased reactive oxygen species, extracellular matrix abnormalities, intra-organelle dysfunction, neurological changes, and immunopathic/endocrinopathic responses.
10.	The degree to which adiposopathy results in metabolic disease largely depends on the interactions and crosstalk with other body organs.

- Sturdy armless chairs, wide chairs with arms, and/or firm sofas in waiting rooms and exam rooms
- Sturdy wide exam tables that avoid or prevent tipping
- Sturdy stools or steps with handles to help patients climb onto the exam table
- Tables/chairs/toilet seats made to sustain higher body weights
- Extra-large patient gowns
- Split toilet seats; provide a specimen collector with a handle
- Reading materials in the waiting room that focus on healthful habits, rather than physical appearance or being "thin"

Appropriate medical devices include [40]:

- Large adult blood pressure cuffs or thigh cuffs that will fit on patients with an upper-arm circumference greater than 34 cm
- Extra-long needles to draw blood
- Large vaginal specula
- Weight scales with the capacity to measure patients who weigh more than 400 pounds
- Weight scales are optimally located in a private area where the value will only be seen by the patient and provider.

7. Overview of adverse clinical consequences of the disease of obesity

The signs, symptoms, and pathophysiology of obesity fulfill the definition of a disease. Contributing factors to the disease of obesity include inheritance (genetic, epigenetic, and/or "environmental inheritance") [41]. Obesity may result in cellular and organ anatomic abnormalities that correspond to cellular and organ functional abnormalities. Obesity may cause pathogenic physical forces resulting from excessive body fat, which promote biomechanical stress damage to other body tissues ("fat mass disease") [3]. Obesity may also result in pathogenic adipocyte and/or adipose tissue endocrine and immune dysfunctions that contribute to metabolic disease (adiposopathy or "sick fat" disease) [42–44]. Fig. 4 describes the two broad categories of adverse clinical consequences of obesity: metabolic and biomechanical. Even when exacerbated by unhealthful behavior, obesity is no less a disease than other diseases promoted by unhealthful behavior. Obesity is a disease that encompasses the patient's lifespan, promoted by genetic predisposition and often progressing with age. In fact, obesity can be viewed as promoting many of the same adiposopathic consequences typically found with aging, such as degenerative cellular processes (Fig. 5), pathogenic genetic effects (Fig. 6), and adverse clinical consequences (Fig. 7).

Pathogenic genetic effects promoted by both obesity and aging include telomere attrition, epigenetic alterations, stem cell exhaustion, and genomic instability [43,45].

Obesity can lead to a variety of adverse clinical consequences typically associated with aging, including dysregulated nutrient sensing, high blood sugar, high blood pressure, high blood lipids, endothelial dysfunction, increased risk of cardiovascular disease and cancer, increased risk of dysfunction of multiple body organ systems, and increased risk of disease burden, polypharmacy, disability, and bias, which may increase risk of depression [43,45].

Table 3
Obesity Medicine Association Classifications of Percent Body Fat. Shown are the OMA classifications based on percent body fat. Percent body fat is a more accurate measure of adiposity than body weight or BMI.

Obesity Medicine Association Classifications of Percent Body Fat in Adults as Assessed by Dual Energy X-Ray Absorptiometry (DXA)		
	Females	Males
Essential fat	<15%	<10%
Athlete	15–19%	10–14%
Fitness	20–24%	15–19%
Acceptable	25–29%	20–24%
Pre-Obesity	30–34%	25–29%
Obesity	>35%	>30%

Table 4
Obesity Medicine Association Classifications of Visceral and Android Fat. Shown are the OMA classifications for optimal and average visceral and android fat for males and females. The pounds, grams, and kilograms listed represent approximate conversion values for the sake of simplicity.

Obesity Medicine Association Classifications of Visceral and Android Fat in Adults		
	Females	Males
Optimal visceral fat	<1 lb. (500 g/0.5 kg)	<1 lb. (500 g/0.5 kg)
Optimal android fat	<3 lbs. (1400 g/1.4 kg)	<3 lbs. (1400 g/1.4 kg)
Average total fat for adults	70 lbs. (30 kg)	80 lbs. (35 kg)
Average visceral fat for adults	2 lbs. (1000 g/1 kg)	3 lbs. (1400 g/1.4 kg)
Average android fat for adults	7 lbs. (3000 g/3 kg)	7 lbs. (3000 g/3 kg)

Abbreviations: lbs: pounds; kg: kilograms.

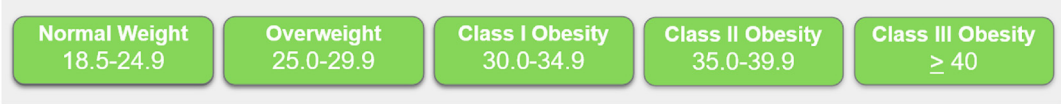

Fig. 8. Body Weight Classification Based Upon Body Mass Index (BMI) in Kilograms Per Meter Squared (kg/m^2). Classifications based on BMI are shown. Different BMI cut-off points may be more appropriate based upon sex, race, ethnicity, and menopausal status. Among Asians, a BMI ≥23 kg/m^2 may be a more appropriate cut-off point to define overweight and to screen for type 2 diabetes mellitus [48]. Among postmenopausal females, BMI may underestimate body fat [49].

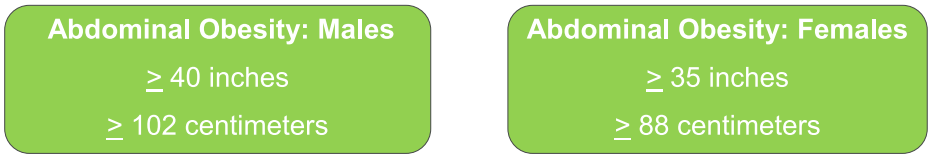

Fig. 9. Waist Circumference Classification for Abdominal Obesity. Abdominal obesity is classified by waist circumferences (WCs) ≥ 40 inches (102 cm) for males and ≥35 inches (88 cm) for females. Different WC abdominal obesity cut-off points are appropriate for different races (e.g., ≥90 cm for Asian males and ≥80 cm for Asian females).

Table 5
Diagnostic Criteria for Metabolic Syndrome. Patients must have three or more of the following five risk factors to be diagnosed with metabolic syndrome (cut offs are defined in the table): abdominal obesity, high triglycerides, low HDL cholesterol, high blood pressure, and high fasting glucose levels.

Diagnostic Criteria	Defining Level
Abdominal obesity	Waist circumference
Male	>40 inches (>102 cm)
Female	>35 inches (>88 cm)
Triglycerides[a]	≥150 mg/dL (1.7 mmol/L)
HDL cholesterol[a]	
Male	<40 mg/dL (1.04 mmol/L)
Female	<50 mg/dL (1.30 mmol/L)
Blood pressure[a]	≥130/≥85 mmHg
Fasting glucose[a]	≥100 mg/dL (5.6 mmol/L)

[a] Patients may also be diagnosed if they do not meet the defining levels but are receiving drug treatment for these diagnostic criteria.

8. Adiposopathy and adiposity-based chronic disease (ABCD)

Adiposopathy is defined as pathogenic adipose tissue anatomic/functional derangements, promoted by positive caloric balance in genetically and environmentally susceptible individuals, that result in adverse endocrine and immune responses that directly and/or indirectly contribute to metabolic diseases (e.g., type 2 diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, and cancer) [3]. Adiposopathy is analogous to the disease state of other body organs, such as cardiomyopathy, myopathy, encephalopathy, ophthalmopathy, retinopathy, enteropathy, nephropathy, neuropathy, and dermopathy. For example, "cardiomyopathy" describes a "disease" wherein pathologic enlargement of heart cells and the heart organ results in anatomic/functional abnormalities leading to adverse clinical consequences [43]. Similarly, "adiposopathy" describes a "disease" wherein pathogenic enlargement of fat cells and the fat organ results in anatomic/functional abnormalities leading to adverse clinical consequences. The adiposopathic complications of obesity are sometimes described as adiposity--based chronic disease (ABCD), which is terminology that may ultimately help improve the International Classification of Diseases, based upon three dimensions: etiology, degree of obesity, and health risks [46].

9. Classification of obesity

Table 2 describes ten takeaway messages regarding obesity classification and consequences. Fig. 8 describes the classification of obesity

Table 6
General Percent Body Fat Correlation with Body Mass Index (BMI): DXA Measurements in U.S. Adults from NHANES 1999–2004. Shown are the mean percent body fats as measured by DXA in males and females for different BMIs according to NHANES 1999–2004 [69]. These numbers are not adjusted for age, race, or ethnicity, which can all contribute to variability in percent body fat [70]. These are population correlations. Correlation of BMI to percent body fat in an individual patient largely depends on the amount of muscle mass in the individual.

BMI*	Total Body Fat	<25 kg/m^2	25–29 kg/m^2	30–34 kg/m^2	>35 kg/m^2
Males % Body Fat (mean)	28%	23%	28%	32%	37%
Females % Body Fat (mean)	40%	34%	41%	44%	48%

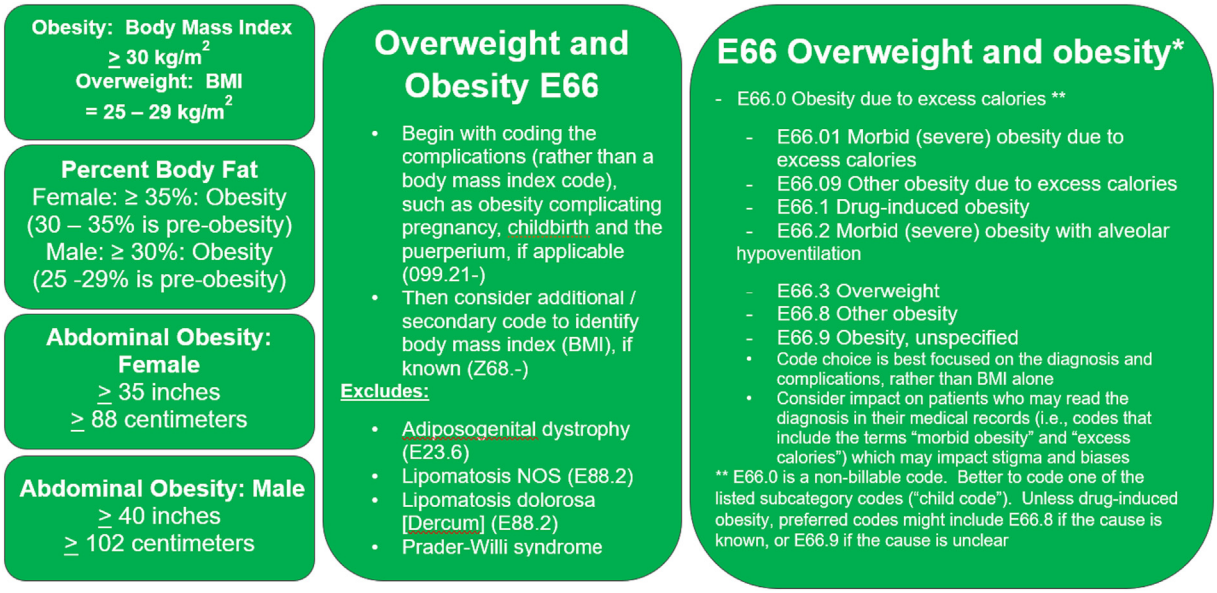

Fig. 10. Summary of OMA Diagnostic Metrics for Obesity and Diagnostic Codes. Diagnostic metrics include BMI, percent body fat, and waist circumference. Codes and code choices should involve the presence of complications, diagnoses, and clinical implications.

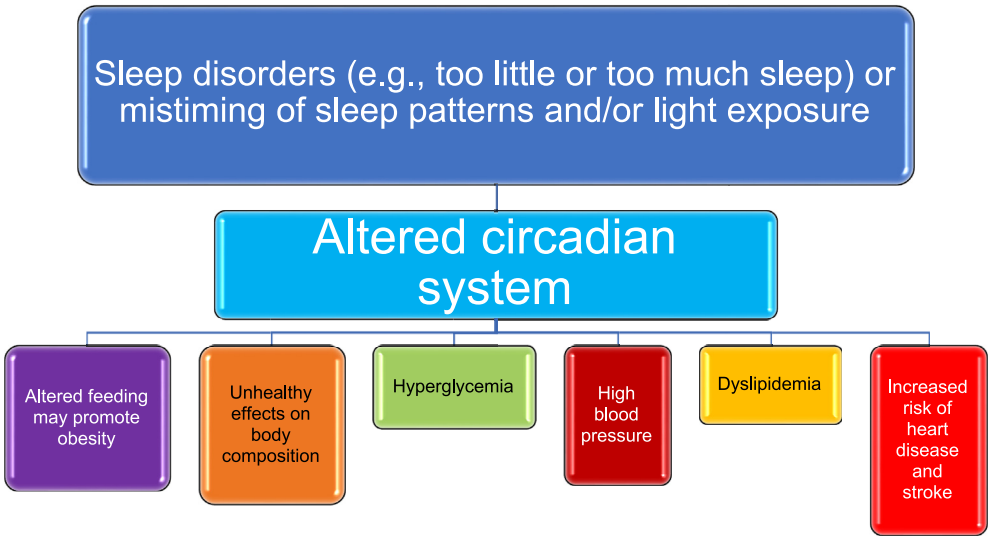

Fig. 11. Sleep Disruption and Obesity. Sleep disorders and obesity are related, and an altered circadian system can lead to altered feeding (which may promote obesity), unhealthy effects on body composition, hyperglycemia, high blood pressure, dyslipidemia, and an increased risk of heart disease and stroke [98–101].

Table 7
Adiposopathic Immunopathies. The adiposopathic consequences of obesity can adversely affect immune processes, leading to fat cell and fat tissue functional abnormalities that promote metabolic diseases [3,104–110].

Increased proinflammatory adipose tissue factors	Decreased anti-inflammatory adipose tissue factors (*e.g.*, adiponectin)
• Factors with cytokine activity (e.g., leptin) • Acute-phase response proteins (e.g., C-reactive protein) • Proteins of the alternative complement system • Chemotactic or chemo-attractants for immune cells • Eicosanoids and prostaglandins (e.g., PGE2) • Inflammatory markers are a subset of metabolites and biomarkers, that, through metabolomic profiling, might help identify the risk and complications of obesity.	• Obesity can increase the number of adipose tissue stromal macrophages and promote a more pro-inflammatory macrophage profile. • Obesity is often reported to have an increased proportion of M1 macrophages (that produce pro-inflammatory tumor necrosis factor, interleukin IL-6 and monocyte chemoattractant protein-1) relative to M2 macrophages (which may produce anti-inflammatory IL-10 and interferons).

based upon body mass index [BMI in kilograms per meter squared (kg/m^2)]. Table 3 describes the Obesity Medicine Association (OMA) classifications of percent body fat. Percent body fat is a more accurate measure of adiposity than body weight or body mass index (BMI) [47]. An increase in BMI may not reflect increased adiposity in those with increased muscle mass. A decrease in BMI may not reflect increased adiposity in those with sarcopenia [47].

Table 4 describes the OMA classifications for visceral and android fat. These cut-off points were derived from analyses, mostly using dual x-ray absorptiometry (DXA), as well as expert interpretation of these data [50]. Total body fat is widely variable and correlates to body weight, height, and sex [48,49,51,52] Visceral and/or android fat directly correlate to adiposopathic metabolic diseases (e.g., diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, and cancer), perhaps more so than waist circumference alone [53]. U.S. adults typically have visceral and android fat at least 2–3 times greater than "optimal." Some individuals (especially females) may have higher percent body fat with limited (and sometimes negligible) visceral fat [54,55]. Visceral adipose tissue often increases linearly five-fold from ages 18 to 82 [55].

General principles regarding assessment of body composition and clinical applications include:

Table 8
Metabolic Manifestations of Adiposopathy. The adiposopathic consequences of obesity promote metabolic diseases and clinical disorders [3,104–106,111–113].

High blood glucose (prediabetes mellitus, type 2 diabetes mellitus)	Acanthosis Nigricans
High blood pressure	Asthma (due to adiposopathic immune and endocrine responses)
Metabolic syndrome	Cholelithiasis
Adiposopathic dyslipidemia	Glomerulopathy
	Hepatosteatosis (nonalcoholic fatty liver disease)
Decreased high-density lipoprotein cholesterol levels	Hyperuricemia and gout
Increased atherogenic particle number (increased apolipoprotein B)	Inflammatory diseases (osteoarthritis, atherosclerosis)
Increased proportion of small, dense, low-density lipoprotein particles	Insulin resistance
Increased triglyceride levels	Nephrolithiasis
Increased triglyceride-rich lipoproteins	
Increased lipoprotein-remnants	Neuropsychiatric diseases (e.g., worsening depression or loss of grey matter due to adiposopathic immune and endocrine responses)
Cardiovascular disease	Pro-thrombotic predisposition
Cancer	Sex hormone irregularities (e.g., polycystic ovary syndrome in females, hypogonadism in males)

- *Scientifically,* for many patients, percent body fat classification is more descriptive/diagnostic than prognostic, and thus somewhat subjective, at least from a cardiometabolic standpoint. In other words, while percent body fat is superior to BMI in describing the degree of adiposity in patients, other measures of body fat have better

Table 9
Genitourinary Manifestations of Obesity in Men. "Fat mass disease" and "sick fat disease" can lead to a variety of genitourinary complications for men. [120–122].

• Hypoandrogenemia	• Urinary stress incontinence
• Hyperestrogenemia	• Infertility
• Erectile dysfunction	• Buried or hidden penis
• Low sperm count	• Psychological barriers to sexual behavior
• Pelvic organ prolapse (e.g., cystocele, rectocele)	• Benign prostatic hypertrophy with urinary hesitancy (and nocturia)

Table 10
Genitourinary Manifestations of Obesity in Females. "Fat mass disease" and "sick fat disease" can lead to a variety of genitourinary complications for females [120–129].

• Hyperandrogenemia	• Gestational diabetes mellitus
• Hirsutism	• Gestational hypertension
• Acne	• Preeclampsia
• Polycystic ovary syndrome	• Increased miscarriage and stillbirth
• Menstrual disorders, anovulation, & infertility	• Overdue pregnancy
• Psychological barriers to sexual behavior	• Increased need for induction
• Urinary stress incontinence	• Increased need for cesarean section with increased complications (delayed healing and wound infection)
• Pelvic prolapse (e.g., cystocele, rectocele, uterine prolapse, vault prolapse)	
• Pregnancy thromboembolism	• Large for gestational age offspring

correlation to cardiovascular disease risk (e.g., visceral and android fat, waist circumference) [53].

- *Categorically,* other percent body fat classifications do not have an "overweight" or "pre-obesity" category. Instead, other percent body fat categorizations go directly from "acceptable" to "obesity," which create challenges for some patients. Words such as "obesity" have meaning beyond simple narrative classifications [56].
- *Comparatively*, elite body builders often have percent body fat for females at < 15% and for males at < 10%, with some fitness-oriented classifications suggesting essential fat may be as low as < 10% in females and <5% in males [56]. However, the intent of the OMA classifications of percent body fat is to provide body composition guidance from the perspective of obesity medicine, not elite athletes.
- *Clinically,* other percent body fat classifications have cut-off points not easily remembered and not clinically superior to cut-off points more easily remembered. For example, a review of the internet reveals that other percent body fat categories vary widely in defining essential body fat, ranging from 8 to 20% in females and 2–13% in males [56]. Essential body fat can be defined as the amount of body fat necessary for hormone and metabolic functions, as well as functions of body organs (e.g., brain, bone marrow, nerves, membranes). In females with amenorrhea due to low body fat, resumption of menses often occurs with percent body fat >20% [57]. Thus, while the OMA threshold for essential body fat may be higher than classifications intended for elite athletes, the OMA cut-off point of <15% and <10% for essential body fat for females and males is within the range of other estimates and may better apply to clinical considerations of patients. Finally, while a percent body fat of >40% may be a better cut-off point to define obesity mortality for females [58], the clinical management of females with pre-obesity (percent body fat 30–34%) and obesity (percent body fat ≥35%) goes beyond death alone and includes management of metabolic and fat mass diseases, which often occur at a percent body fat <40%.
- *Pragmatically*, for males, the OMA percent body fat classifications have some cut-off points similar to more familiar cut-off points for BMI (e.g., overweight and obesity), with the cut-off points for females being 5% higher than males for each classification.
- *Prognostically,* waist circumference, visceral fat, and android fat better correlate to cardiometabolic disease than BMI or percent body fat [53]. Nonetheless, using the OMA classifications of percent body fat, approximately 50% of adult males and females may be classified as having obesity.

Fig. 9 describes the general waist circumference (WC) criteria for

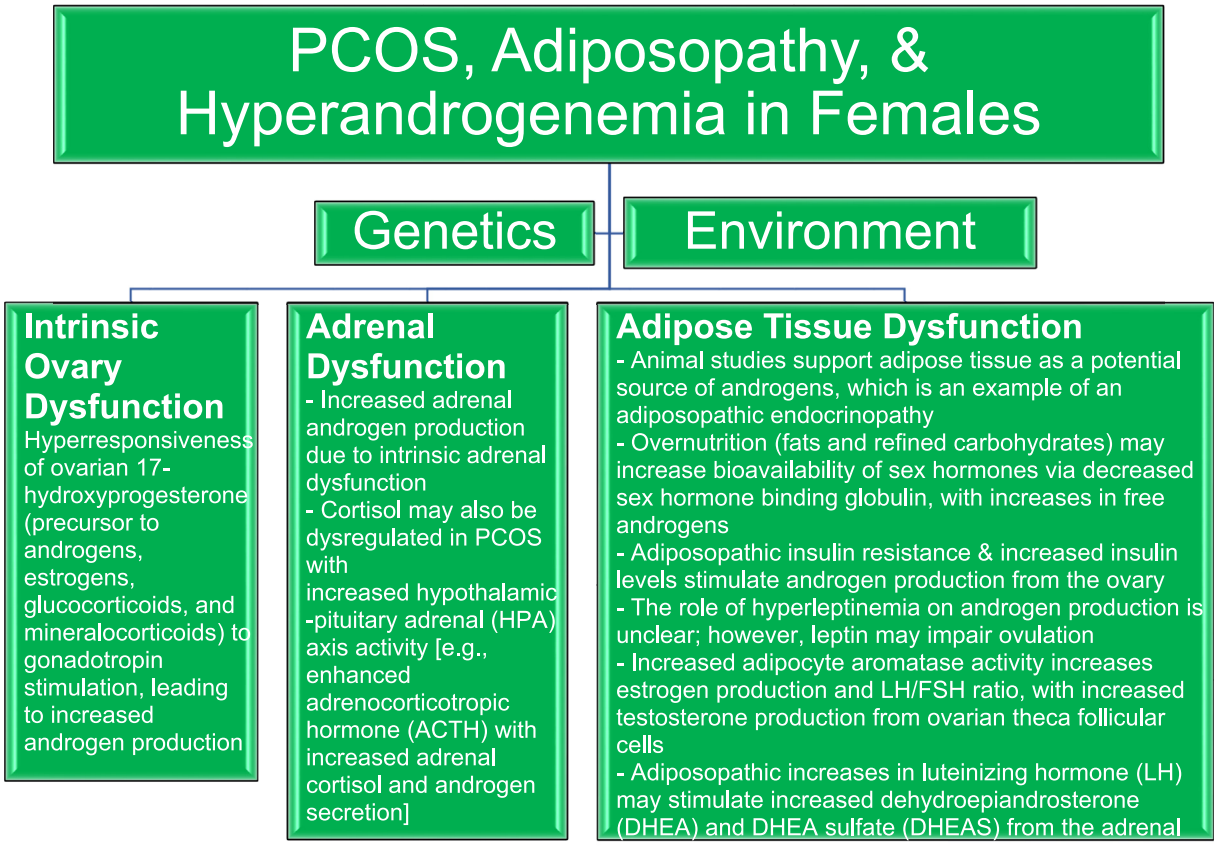

Fig. 12. Adiposopathic Consequences of Obesity Leading to Polycystic Ovary Syndrome. Through a combination of genetics and environment, obesity can lead to intrinsic ovary dysfunction, adrenal dysfunction, adipose tissue disfunction, and the clinical manifestations of polycystic ovary syndrome.

Table 11
Polycystic Ovary Syndrome Treatments. A variety of treatments exist for the complications associated with PCOS. [116,130].

Complication	Examples of Common Treatments
Increased body weight	Healthful nutrition and physical activity Metformin Glucagon-like protein – 1 receptor agonist Anti-obesity drugs
Insulin resistance	Metformin, thiazolidinediones, and fibroblast growth factors
Irregular menses	Oral contraceptives
Acne	Isotretinoin
Alopecia	Cyproterone acetate, finasteride, topical minoxidil
Hirsutism	Eflomithine (topical), spironolactone, metformin
Infertility	Clomiphene
Hyperandrogenemia	Gonadotropin releasing hormone analogs Ketoconazole Corticosteroids Spironolactone Flutamide
Hypercholesterolemia	Statins

Table 12
Obesity and Adiposopathy Increase the Risk of Sex-Related Genitourinary Cancers. [131–136].

- Ovarian cancer
- Cervical cancer
- Bladder cancer
- Breast cancer (postmenopausal)
- Endometrial/uterine cancer

abdominal obesity. Different WC abdominal obesity cut-off points are more appropriate for different races (e.g., ≥90 cm for Asian males and ≥80 cm for Asian females) [48,48,59,60]. Waist circumference correlates to increased risk for cardiovascular disease [61]. Various waist circumference ratios (i.e., ratio to height and hip) may provide additional predictive risk information. However, whether these additional ratio metrics influence patient care to a clinically meaningful degree is uncertain. The methodology for measuring waist circumference varies, and includes, (a) at the level of the iliac crest, (b) at the midpoint between highest point of iliac crest and lowest rib, and (c) measurements made at the level of the umbilicus [62]. According to the National Institutes of Health, waist circumference is best measured at the highest point of the iliac crest, while the World Health Organization recommends measuring at the midpoint between the lower border of the rib cage and the iliac crest [63]. From a cross-sectional standpoint, the best clinical measure of waist circumference is probably at the level of the iliac crest or at the midpoint between highest point of iliac crest and lowest rib [64]. From a longitudinal standpoint, response to obesity treatment is best assessed by

Table 13
Practice Summary. This table lists practice summary items for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Practice Summary	Page
Practice name	?
Add to existing practice or stand-alone obesity medicine practice	?
Mission	?
Objectives	?
Treatment priorities	?
Goals	?
Staffing and corporate structure	?
Staff licenses	?
Training (staff training, people first language, motivational interviewing)	?
Leadership training	?
Biannual employee evaluation template/format	?

Table 14
Business Startup. This table lists business startup items for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Business Startup	Page
Incorporate	?
Corporate documents (articles of incorporation and stock)	?
Board of Directors and shareholders (and minutes)	?
Trademark business name	?
Attorney	?
Bank/loan	?
Accountant	?
Accounting system	?
Insurance or cash pay or both	?
Health insurance provider contracts	?
Laboratory	?
Office zoning/building/purchasing/renting/sharing	?
Billing (in-house or billing service)	?
Credit card processors	?
Payroll (in-house or vendor)	?
Insurances (e.g., malpractice, health, business, workman's compensation, umbrella)	?
Marketing	?
Website (self-made and self-maintenance or professionally made with professional maintenance)	?
Information technology (IT) support	?
Phone systems	?
Electronic health records	?

Fig. 13. Obesity Medicine Practice Corporate Structure Template. This figure shows a recommended corporate structure for an obesity medicine practice. Not all items shown may apply to an individual obesity medcine practice.

Table 15
Equipment. This table lists equipment to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings. Additional equipment may include physical exercise equipment, if considering an affiliated physical exercise program.

Equipment	Page
Office furniture (obesity compliant)	?
Software	?
Desktop computers	?
Laptop computers (onsite and home use/virtual private network)	?
Server, network, email, Internet	?
Phones	?
Printers	?
Faxes	?
Alarm systems	?
Surveillance cameras	?
Scale with greater than 400 lb. capacity	?
Stadiometer for measuring height	?
Tape measures for measuring waist circumference	?
Body composition machine if providing as a service [137]	?
Indirect calorimeter if providing this service	?

Table 16
Services. This table lists services to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Services	Page
Obesity management (including frequency of visits)	?
Nutritional counseling and dietary services (very low-calorie diets, meal replacements)	?
Physical activity counseling and physical exercise training	?
Psychological counseling and behavior modification	?
Diagnostic blood work	?
Other procedures (e.g., electrocardiogram)	?
Body composition (e.g., dual x-ray absorptiometry, bioelectrical impedance, calipers, underwater weighing)	?
Telemedicine	?
Group sessions	?
Dispensing medications/vitamins	?
Pricing of services	?

consistently using the same waist circumference measurement method over time.

Table 5 describes the diagnostic criteria for metabolic syndrome. Metabolic syndrome is not a disease; it is a descriptive clustering of atherosclerotic cardiovascular risk factors [65]. Abdominal obesity is the only diagnostic physical finding for metabolic syndrome. Central obesity is a clinical marker of adiposopathy; increased visceral adiposity is a surrogate for global (integrative) fat dysfunction [3]. While metabolic syndrome is intended to reflect cardiovascular disease (CVD) risk, and while metabolic syndrome does include lipid parameters for its diagnosis, the diagnostic criteria for metabolic syndrome does not include low density lipoprotein cholesterol levels [61]. Finally, the diagnostic criteria for metabolic syndrome may vary depending on the organization

Table 17
Practice Priorities and Philosophies. This table lists practice priorities and philosophies to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Practice Priorities and Philosophy	Page
Nutritional priorities and philosophy	?
Physical activity priorities and philosophy	?
Behavior modification activity priorities and philosophy	?
Fat mass disease monitoring	?
Sick fat (adiposopathic) metabolic disease monitoring	?
Quality of life monitoring	?
Secondary causes of obesity (concomitant medications, medical disorders)	?
Anti-obesity pharmacotherapy priorities and philosophy	?
Bariatric surgery priorities and philosophy	?
Body sculpting	?

Table 18
Office Policies and Procedures. This table lists office policies and procedures to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Office Policies and Procedures	Page
Employee policies and procedures	?
Employee roles and responsibilities	?
Professional contracts and agreements	?
Employee contracts and agreements (confidentiality, non-disclosure, and non-competition agreement; waiver for use of exercise equipment; children/guests in workplace policies; termination of employment policies)	?
Racial Discrimination and Sexual Harassment Policies	?
Consolidated Omnibus Budget Reconciliation Act (COBRA) Policies	?
Basic Life Support or Advanced Life Support and defibrillator training	?
Health Insurance Portability and Accountability Act (HIPAA) policies	?
Smoking policies	?

Table 19
Standard Operating Procedures (SOPs) for Office Procedures. This table lists office procedure SOPs to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Standard Operating Procedures (SOPs) for Office Procedures	Page
Body mass index	?
Waist circumference	?
Percent body fat and body composition assessment	?
Energy expenditure assessment (e.g., indirect calorimetry)	?
Blood pressure	?
Pulse	?
Phlebotomy	?
Electrocardiogram	?
Questionnaires for quality of life, depression, and dietary assessment	?
SOPs for SOPs	?
Practice audits	?

Table 20
Patient Materials. This table lists patient materials to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Patient Materials	Page
Office brochure	?
Patient welcome letters	?
Health Insurance Portability and Accountability Act & Practice Privacy Policies	?
Informed consent documents/forms (e.g., practice/patient expectations, virtual telehealth visits, phlebotomy, body composition procedures, energy expenditure procedures, very low-calorie diets, meal plans)	?
Educational materials	?
Food journals	?
Physical activity logs	?
Photo journals	?
Electronic medical records history and physical exam templates	?

Table 21
Certifications and Ongoing Training. This table lists certifications and training to consider for starting an obesity medicine practice. The intent is to provide a Standard Operating Procedure (SOP) template, with the listed items being headings to be followed by details applicable to the individual practice. The question marks are intended to represent the pages that describe the location of the listed SOP headings.

Certifications and Ongoing Training	Page
American Board of Obesity Medicine (ABOM)	?
Credentialed in Advanced Education in Obesity Management	?
ABOM review course (e.g., Obesity Medicine Association ABOM review course)	?
Obesity society scientific sessions (e.g., Obesity Medicine Association)	?
Obesity Medicine Association Obesity Algorithms (Adult and Pediatric)	?
Obesity Medicine Association Clinical Practice Statements and other OBESITY PILLARS publications	?
Obesity Medicine Association Self-Assessment Program (OMA SAP)	?
Obesity Medicine Association webinars	?
Continuing Medical Education	?
Obesity-specific staff training (e.g., weight bias, person-first language, overall sensitivity)	?
Hazardous Materials (HazMat) and International Air Transport Association (IATA) training	?

crafting the diagnostic criteria. Similarly, waist circumference diagnostic criteria may vary depending upon race and sex [60].

Finally, Fig. 10 provides a summary of diagnostic metrics and codes applicable to the diagnosis of obesity via BMI, percent body fat, and waist circumference.

9.1. Body mass index (BMI)

Advantages of BMI measurements [47]:

- Increased BMI generally correlates with metabolic and fat mass diseases in population studies.
- Commonly used
- Reasonably reproducible
- Low cost
- Adequate measure for epidemiological studies
- Adequate screening metric for most patients

Disadvantages of BMI measurements:

- While BMI can estimate percent body fat in populations, BMI may not always correlate well with body composition, metabolic disease, and fat mass diseases in an individual patient [47].
- Does not account for increases or decreases in muscle mass [47]; may over-diagnose obesity in muscular individuals and under-diagnose obesity in patients with sarcopenia [47].
- BMI cut-off points do not always distinguish between males and females, nor take into account ethnic and racial considerations [48,51,66].
- May not be an appropriate indicator of body fat in postmenopausal females [67].
- Should not be the sole measure of adiposity for all patients

9.2. Percent body fat

Table 6 describes general percent body fat correlation with BMI via dual-energy x-ray absorptiometry (DXA) measurements of U.S. adults from the National Health and Nutrition Examination Survey (NHANES) 1999–2004.

Advantages of percent body fat measurements [56]:

- More specific assessment of body fat
- May be a reasonable longitudinal measure, especially in patients who may not be losing weight but are engaged in resistance exercise training, and thus may be losing body fat while increasing muscle

Disadvantages of percent body fat measurements [68]:

- Some measurement techniques are not always accurate, nor easily reproducible. For example, even with proper placement and multiple measures, skinfold calipers can vary from more accurate measures of percent body fat by 10% or more.
- Electronic body fat measurements are more expensive than calipers.
- The accuracy and reproducibility of electronic body fat measurements are dependent upon the equipment and software, technique, expertise of the technician, and, with some measures, the condition of the patient at time of measurement (e.g., state of hydration).
- Cut-off points for percent body fat are not validated to correlate to metabolic disease within the individual patient.
- While percent body fat may provide diagnostic information that is more useful than body mass index for many individuals, it is the amount of android and visceral fat (abdominal obesity) that best correlates with metabolic disease and cardiovascular disease risk.
- Reference values for centile percent body fat are often based on databases over a decade old.
- Age less than 40 years is generally associated with a lower percent body fat than age greater than 40 years.
- An analysis of DXA performed in U.S. Caucasian adults from 2003 to 2015 reported that, depending on age:

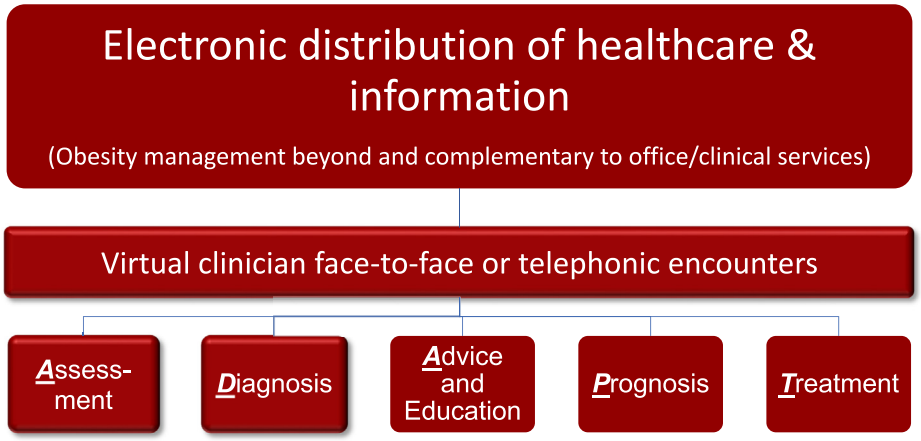

Fig. 14. The Obesity Medicine Association "ADAPT" Telehealth Obesity Management Model. Telehealth is an increasingly important part of clinical practice. This figure provides a summary of the OMA "ADAPT" model for obesity management.

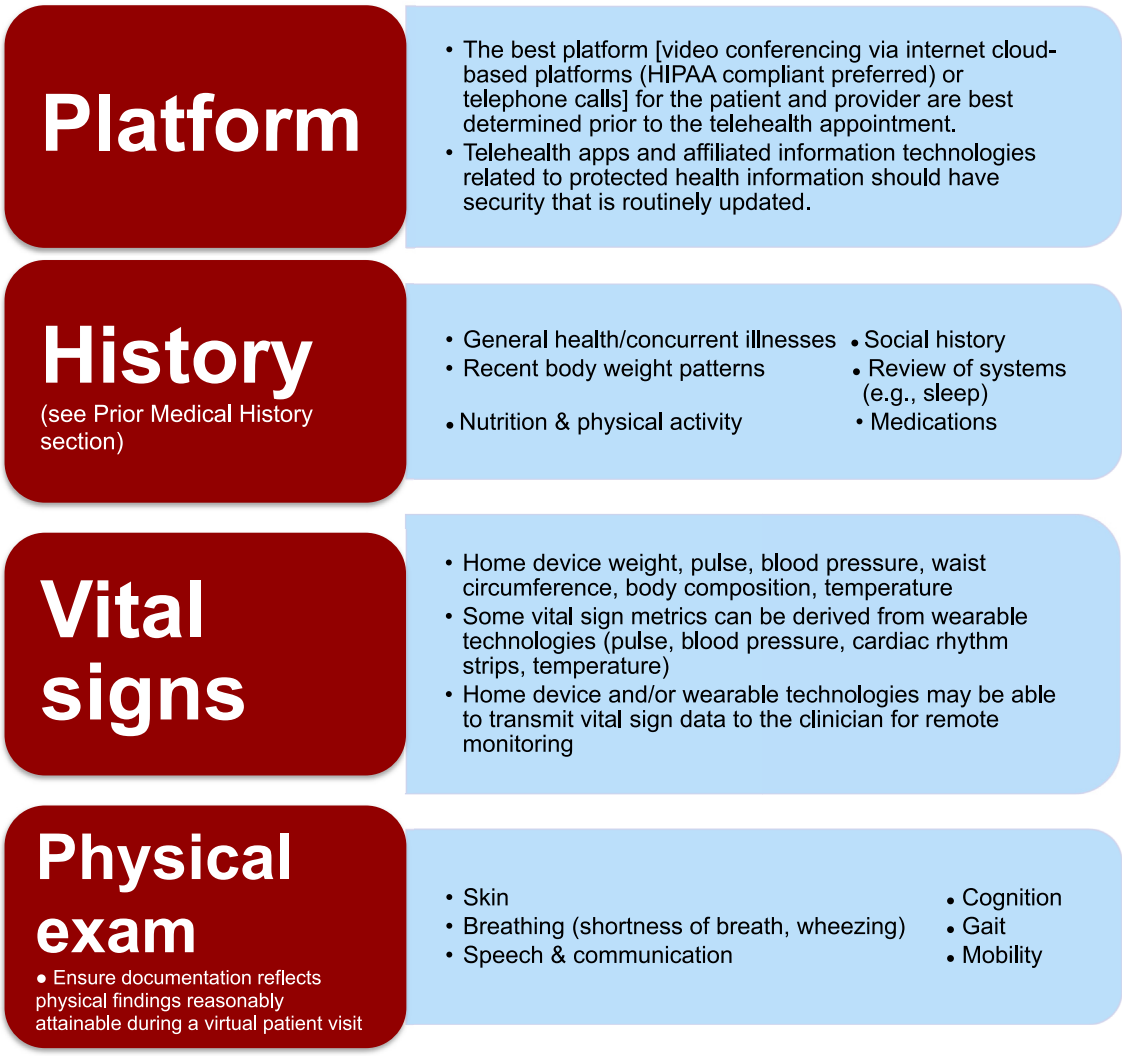

Fig. 15. The OMA "ADAPT" Telehealth Obesity Management Model: Assessment. Assessment is the first step ("A") of the OMA "ADAPT" Model.

- o The upper 50th centile of percent body fat is greater than 30%–43% for females and greater than 20%–32% for males [50].
- o The upper 10th centile of percent body fat is greater than 43%–52% for females and greater than 32%–41% for males [50].

9.3. *Waist circumference (WC)*

Advantages of waist circumference measurements [71]:

- Well-correlated to metabolic and cardiovascular disease
- WC is an individualized anatomical measure of adipose tissue deposition, with an increase in waist circumference reflective of adipose tissue dysfunction.
- Correlates well with total abdominal fat
- Low cost

Disadvantages of waist circumference measurements [71]:

- Measurements are not always reproducible.
- Waist circumference is not superior to BMI in correlating to metabolic disease in patients with BMI $\geq$35 kg/m^2.
- Racial/ethnic differences exist in the cut-off points that correlate to an increased risk of metabolic disease [59,60].
- WC may not correlate well with intraperitoneal (visceral) fat, which can vary depending on sex, race, and ethnicity [72,73].
- WC may not correlate well with intraperitoneal (visceral fat) in patients with prior abdominal liposuction.

9.4. *What is the best measure of obesity?*

9.4.1. *Population assessments of obesity*

- An increase in body mass index (BMI), waist circumference (WC), and percent body fat (BF) all generally correlate with an increased prevalence of metabolic syndrome [68].

9.4.2. *Individual assessments of obesity*

- BMI is a reasonable initial screening measurement for most patients.
- WC provides additional information regarding adipose tissue function/dysfunction and predisposition to metabolic disease among individuals with BMI <35 kg/m^2 [68].
- Percent BF may be especially useful in patients with extremes in muscle mass (i.e., individuals with sarcopenia or substantial increases in muscle mass) and thus may be a more accurate measure of body composition when assessing the efficacy of interventions directed towards change in fat mass and muscle mass [68].
- Percent BF accuracy is not compromised by differences in sex, race, ethnicity, or individual variations in body fat distribution [68].

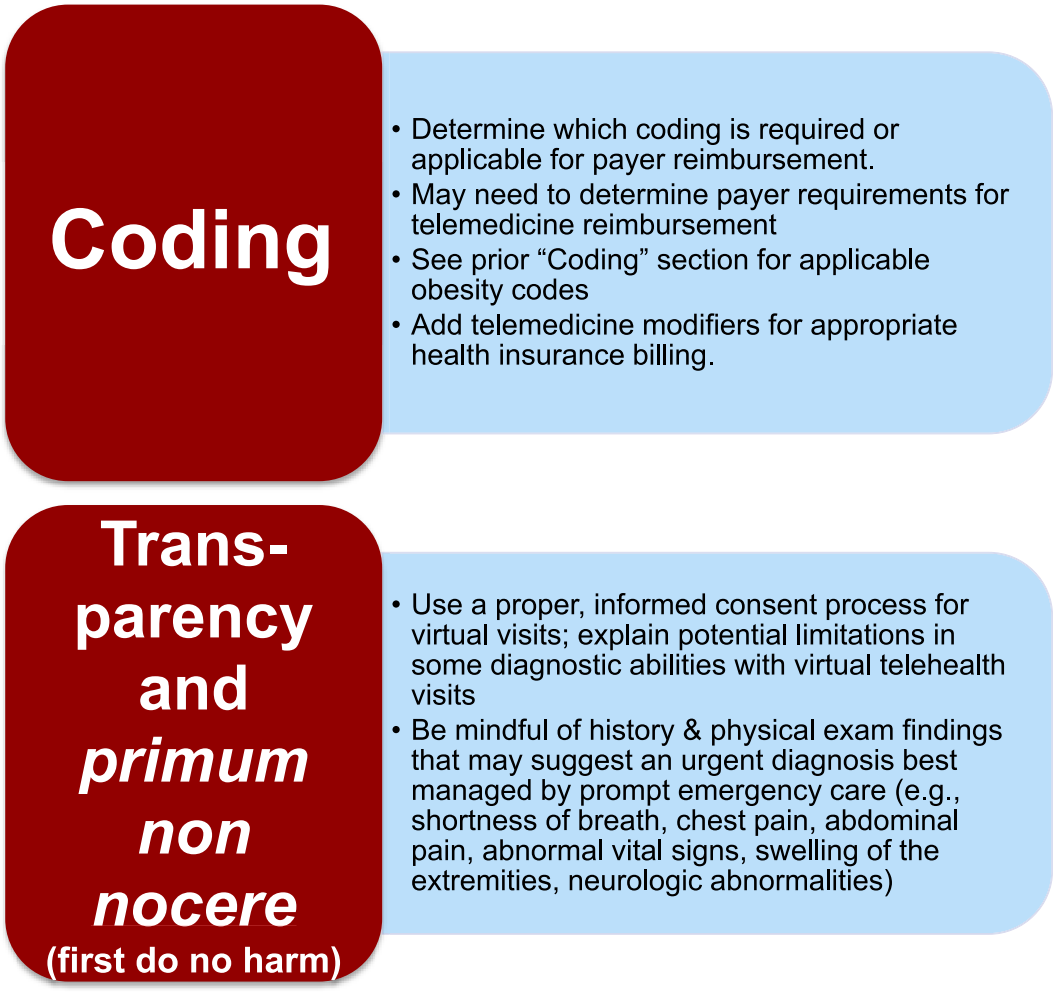

Fig. 16. OMA "ADAPT" Telehealth Obesity Management Model: Diagnosis. Diagnosis is the second step ("D") of the OMA "ADAPT" model and covers coding, transparency, and *primum non nocere*.

- Percent BF may provide more detailed information regarding body composition, which, if accompanied by other measurements (e.g., android fat, visceral fat, lean body mass), may assist clinical assessment and potentially better help with patient motivation [68].

9.5. The Edmonton obesity staging system (EOSS)

The EOSS is a five-stage obesity classification system that incorporates metabolic, physical, and psychological parameters [74].

- Stage 0: No apparent risk factors, no physical symptoms, no functional limitations, and/or no impairment of wellbeing
- Stage 1: Presence of obesity-related subclinical risk factors, mild physical symptoms, mild psychopathology, mild functional limitations, and/or mild impairment of well-being
- Stage 2: Presence of established, obesity-related chronic disease; moderate psychopathology; moderate functional limitations; and/or impairment of well-being
- Stage 3: Established end-organ damage, significant psychopathology, significant functional limitations, and/or impairment of well-being
- Stage 4: Severe (potentially end-stage) disabilities from obesity-related chronic diseases, severe disabling psychopathology, severe functional limitations, and/or severe impairment of well-being

10. Fat mass disease and weight bias

10.1. General biases applicable to patients with obesity

- Society
- Family
- Workplace
- Harassment
- Bullying

10.2. Healthcare biases applicable to patients with obesity [75]

- Provider negative attitudes and negative perceptions about people with obesity can affect medical judgment, interpersonal behavior, and decision making—all leading to compromised care.
- Patient experiences of poor and/or demeaning interactions with health care providers may cause patient stress, avoidance of care, mistrust, and diminished adherence to treatment.

10.3. External perception bias or negative self image words and phrases applicable to patients with obesity [75,76]

- "Unmotivated"
- "Weak-willed"

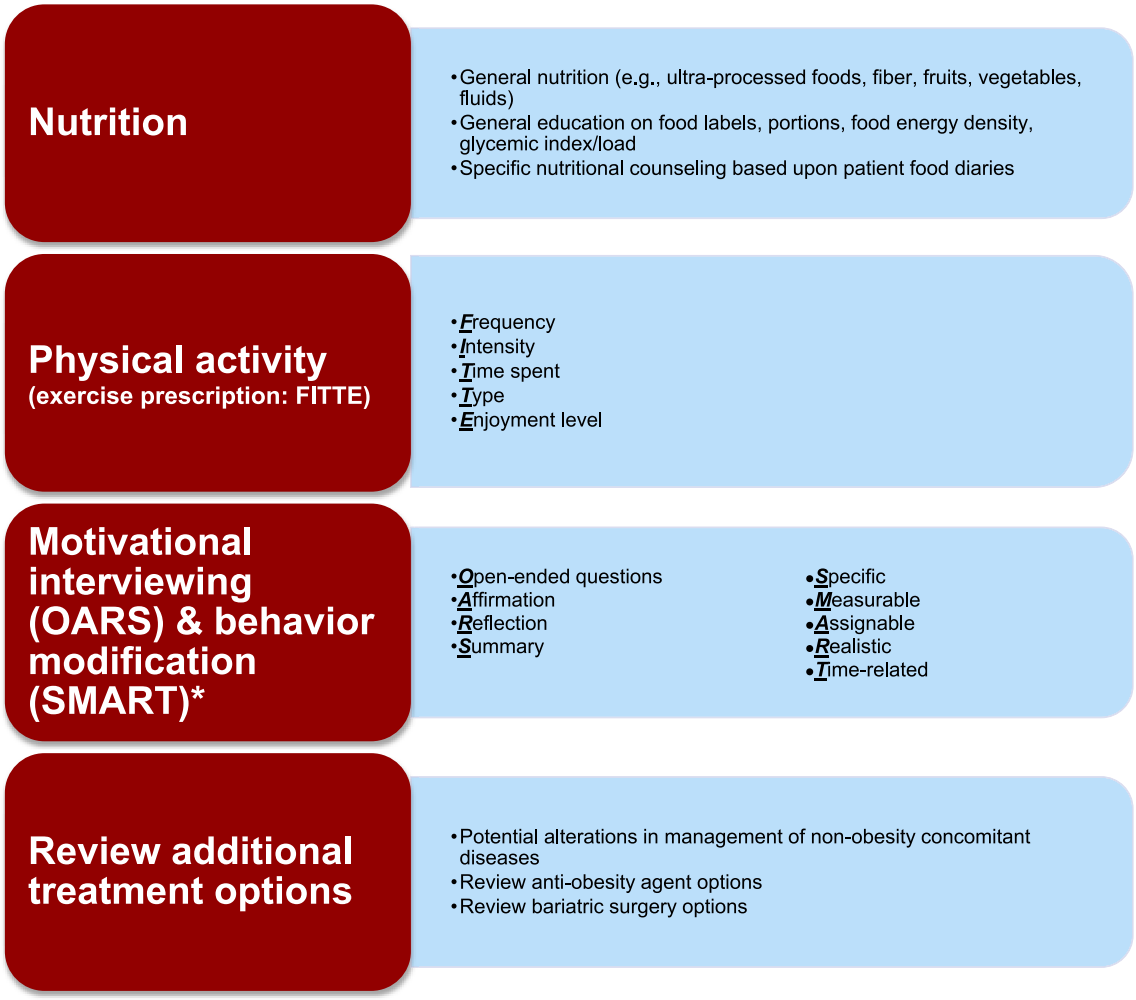

Fig. 17. OMA "ADAPT" Telehealth Obesity Management Model: Advice and Education. Advice and education are the third step ("A") in the ADAPT model, covering nutrition and physical activity recommendations, motivational interviewing, behavior modification, and reviewing of additional treatment options.
*Remote monitoring via home devices or wearable technologies may enhance accountability.

- "Less intelligent"
- "Less attractive"
- "Unsuccessful"
- "Overindulgent"
- "Lazy"

10.4. Weight bias internalization applicable to patients with obesity [76]

- Increased body fat can contribute to self-stigmatization.
- Weight stigma may contribute to mental stress, leading to adiposopathic stress responses and metabolic disease.

10.5. Psycho-social impacts of weight bias applicable to patients with obesity [77]

- Depression
- Hopelessness
- Low self-esteem
- Body-image dissatisfaction
- Diminished sex drive
- Impaired intimacy and sexual relationships
- Decreased work productivity
- Increased work absenteeism

11. Brief overview of common complications of obesity [78,79]

11.1. Cardiovascular [80]

- Congestive heart failure and *cor pulmonale*
- Heart failure, especially heart failure with preserved ejection fraction (HFpEF)
- Varicose veins
- Thromboembolic events (i.e., pulmonary embolus, stroke)
- Hypertension (i.e., compression of kidney)

11.2. Cancer [80]

Obesity increases the risk of cancer of the biliary tract, bladder, brain (i.e., meningiomas), breast (i.e., postmenopausal), cervix, colon/rectum, endometrium/uterus, ovary, esophagus, gallbladder, head and neck, kidney, leukemia, multiple myeloma, non-Hodgkin lymphoma, liver, pancreas, prostate (prognosis is worse, not necessarily increased risk), stomach, and thyroid.

11.3. Neurologic [81]

- Reduced subcortical brain grey matter

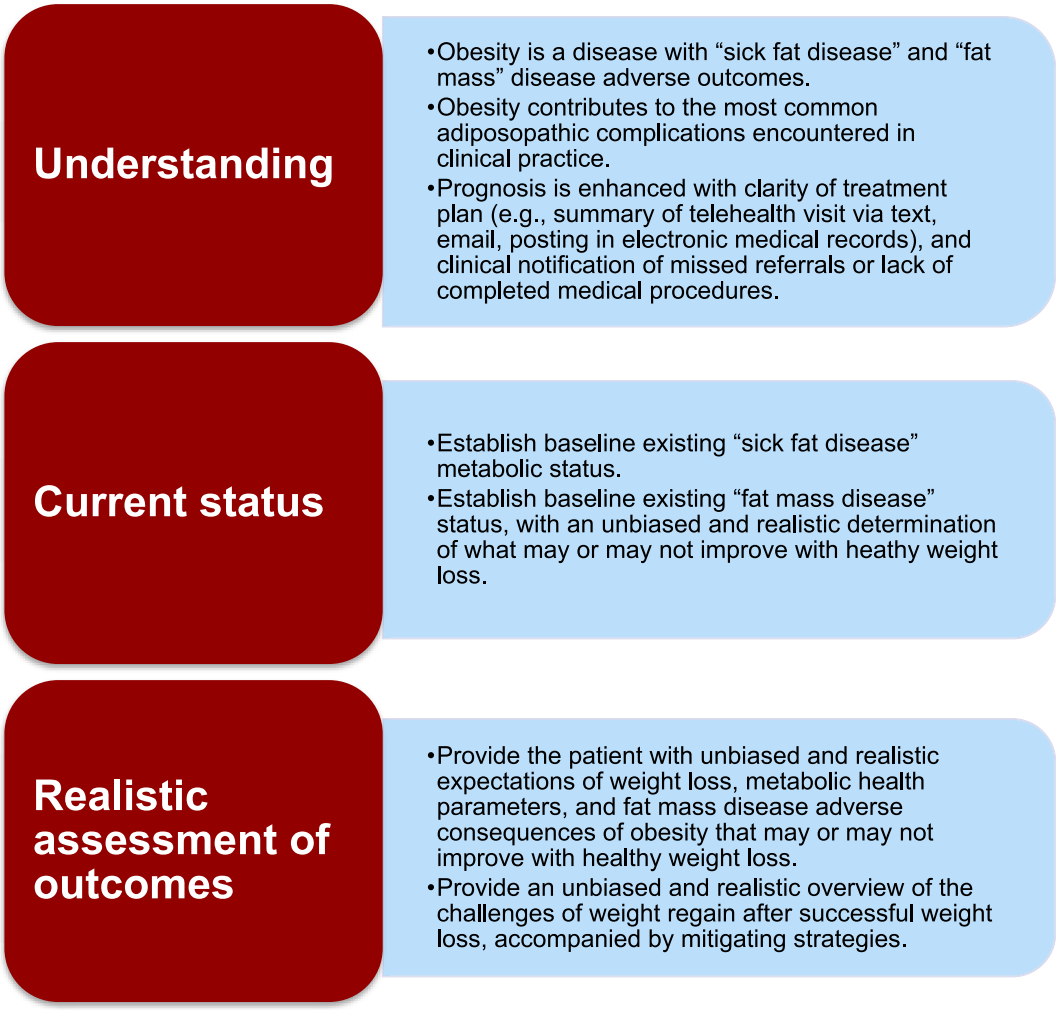

Fig. 18. OMA "ADAPT" Telehealth Obesity Management Model: Prognosis. Prognosis is the fourth step ("P") of the ADAPT model and includes unbiased and realistic discussions with the patient regarding their treatment plan, status, and potential outcomes after treatment.

- Intracranial hypertension (pseudotumor cerebri) with increased intra-abdominal pressure and sleep apnea and impaired cranial venous return
- Stroke
- Nerve entrapment (i.e., meralgia paresthetica, carpal tunnel syndrome)

11.4. Gastrointestinal [80]

- Gastroesophageal reflux
- Hernias
- Non-alcoholic fatty liver disease and non-alcoholic steatohepatitis

11.5. Integument [80]

- Striae distensae (skin stretch marks)
- Stasis pigmentation
- Venous stasis ulcers
- Cellulitis
- Skin tags
- Intertrigo (i.e., bacterial or fungal skin fold infections)
- Carbuncles

11.6. Musculoskeletal

- Immobility
- Osteoarthritis (e.g., knees, hips)
- Low back pain
- Myalgias
- Altered center of gravity
- Impaired balance

11.7. Fat Mass Disease Orthopedic Complications [82–85]

- Biomechanical stress
- Obesity limits mobility and can contribute to orthopedic disabilities.
- Increased risk of orthopedic surgery complications (e.g., infection and sepsis, thromboembolism, trauma, musculoskeletal damage, organ impairment/failure, reduced long-term implant viability, and increased mortality). Advantages of weight loss in patients with obesity pre- and post-orthopedic surgery include reduced operative difficulties and complications and reduced stress to joints with reduced pain and disability.
- Beyond the biomechanical adverse consequences of fat mass disease, adiposopathic chronic inflammation may contribute to osteoarthritis.

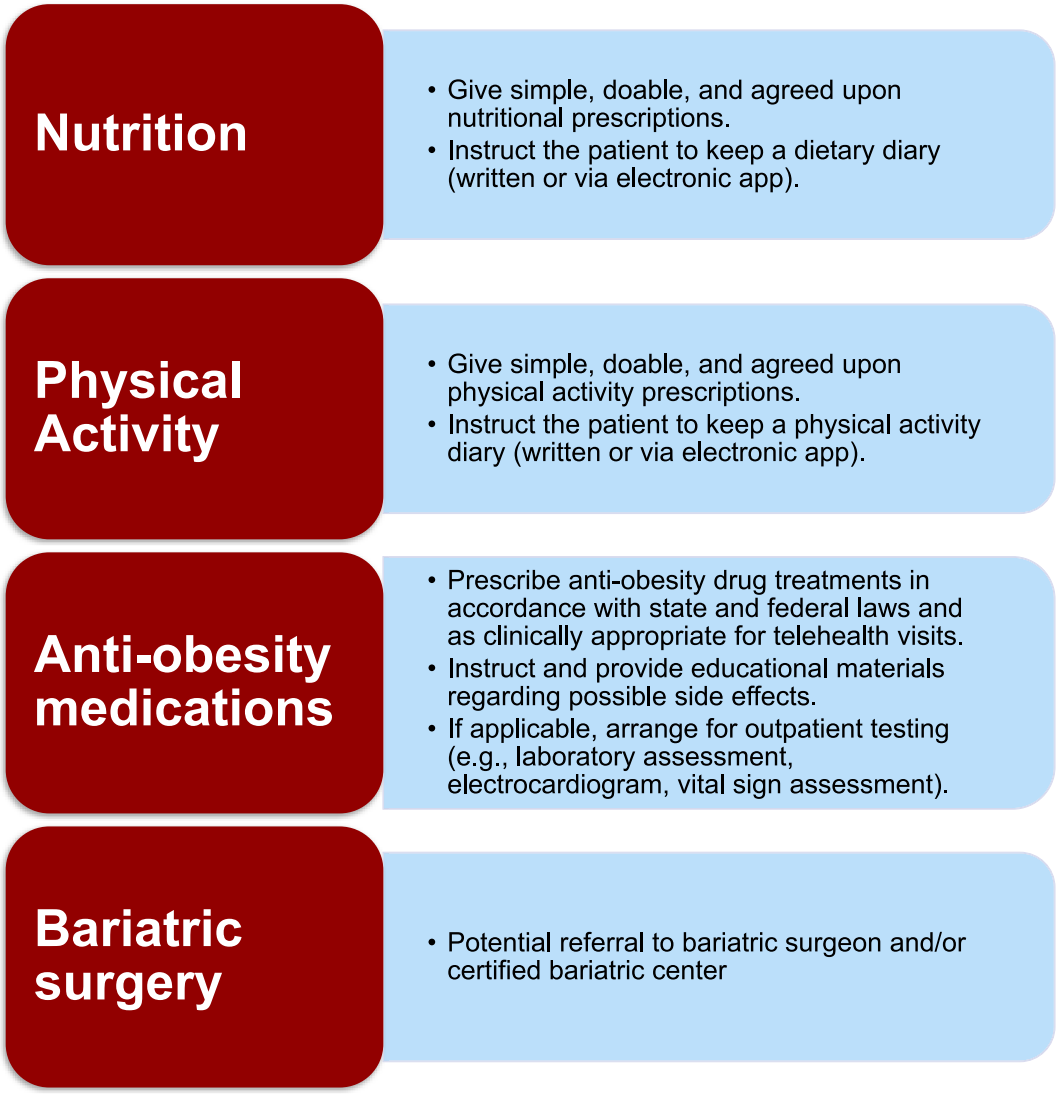

Fig. 19. OMA "ADAPT" Telehealth Obesity Management Model: Treatment. Treatment is the final step of the ADAPT model ("T") and can include changes to nutrition and physical activity as well as implementation of anti-obesity medications or referral for bariatric surgery.

11.8. Pulmonary [86]

- Dyspnea
- Obstructive sleep apnea
- Hypoventilation/Pickwickian syndrome
- Asthma
- Obesity increases the risk for, and increases the severity of, upper respiratory tract infections (URI), including viral (influenza and coronavirus) infections [87–91].
- Patients with obesity may have fat mass disease, such as baseline compromise of lung function, with limited margin for further impairment of lung function (e.g., reduced tidal volume, reduced forced expiratory volume (FEV 1), sleep apnea, as well as daytime and nighttime hypoxia).
- Patients with obesity may also have sick fat disease (adiposopathy) which can predispose them to infections and worse outcomes via disruption of innate and acquired immunity and pro-inflammatory responses [3].
- Patients with obesity may also have competing financial obligations (e.g., polypharmacy, medical office visits) from treatment of common adiposopathic metabolic complications of obesity (e.g., cardiovascular disease, diabetes mellitus, hypertension, dyslipidemia) that may impair urgent and chronic medical care for upper respiratory tract infections.
- Fear of contracting coronavirus or other air-borne contagions may also limit urgent and chronic medical care for obesity, cardiovascular disease events, and metabolic diseases.

12. Sleep apnea

Sleep apnea is commonly associated with obesity. Other sleep disorders associated with obesity include insomnia and restless leg syndrome.

12.1. Signs and symptoms of sleep apnea determined from medical history [92,93]

- Snoring (usually loudly)
- Insomnia
- Restless sleep
- Sudden wakening with choking or gasping
- Headaches
- Daytime sleepiness
- Fatigue
- Motor vehicle accidents (a potential complication of sleep disorders)

- Forgetfulness
- Mood changes
- Lack of interest in sexual behavior
- Gastroesophageal reflux

12.2. Sleep apnea physical findings [92,93]

- Increased neck circumference:
  - o Neck circumference cut-off points that define increased obstructive sleep apnea risk can vary
  - o Cut-off points of neck circumference thought to increase the risk of sleep apnea are ≥17 inches for males and ≥16 inches (or sometimes ≥15 inches) for females.
- Head abnormalities that may predispose patients to obstructive sleep apnea:
  - o Modified Mallampati score of 3 or 4
  - o Retrognathia
  - o Lateral peritonsillar narrowing
  - o Macroglossia
  - o Tonsillar hypertrophy
  - o Enlarged uvula
  - o High arched/narrow palate
  - o Nasal abnormalities
  - o Overbite
- Cardiopulmonary abnormalities associated with sleep apnea:
  - o Peripheral edema
  - o Cardiac dysrhythmia
  - o High blood pressure

12.3. Diagnosis of sleep apnea [94,95]

- Questionnaires can be used to diagnose sleep apnea. Common questionnaires include:
  - o Berlin Sleep Questionnaire
  - o Epworth Sleepiness Scale
  - o STOP-BANG Questionnaire (STOP = Snoring, Tiredness, Observed apnea and high blood Pressure; BANG = BMI, Age, Neck circumference, Gender)

12.4. Testing for sleep apnea

Sleep apnea can be diagnosed using overnight sleep studies (i.e., home sleep tests or multiple sleep latency tests). The apnea hypopnea index can be used to classify the level of severity [95].

- Apnea is the absence of breathing; hypopnea is often defined as 10 seconds or more of shallowed breathing and is associated with reduced blood oxygen saturation.
- Apnea hypopnea index (AHI) severity levels:
  - o 5–15 episodes/hour: mild sleep apnea
  - o 15–30 episodes/hour: moderate sleep apnea
  - o 30 episodes/hour: severe sleep apnea

12.5. Treatments for sleep apnea [96,97]

- Reduction of fat mass
- Behavior therapy to improve sleep patterns
- Oral appliances
  - o Mandibular reposition devices
  - o Tongue retaining devices
- Nasal expiratory positive airway
- Continuous positive airway pressure
- Adaptive servo-ventilation
- Surgery to treat sleep apnea
  - o Laser-assisted uvulopalatoplasty
  - o Radiofrequency ablation
  - o Palatal implants
  - o Electrical stimulation of upper airway muscles
  - o Skeletal surgery procedures

13. Sleep disruption and obesity

A diurnal rhythm is an endogenous or exogenous response synchronized with the day/night cycle. A circadian rhythm (sleep/wake cycle) is an endogenously generated response synchronized to a 24-h day [98]. Fig. 11 describes the adverse consequences of sleep disorders and how they are related to obesity.

14. Adiposopathy or "sick fat disease"

14.1. Anatomic changes [3,102]

- Positive caloric balance may lead to adipocyte hypertrophy with variable increases in adipocyte number, as regulated by intracellular:
  - o Sterol regulatory element binding protein-1 (SREBP1)
  - o Peroxisome proliferator-activated receptor (PPAR) gamma
  - o CCAAT-enhancer binding proteins (C/EBPs)
- When adipogenesis (proliferation and differentiation) is impaired in peripheral subcutaneous adipose tissue (SAT), inadequate storage of excess energy in SAT may result in energy overflow and increased circulating free fatty acids. This may lead to:
  - o Worsening adipocyte hypertrophy and adipocyte dysfunction
  - o Increasing ("ectopic") fat deposition in other depots:
    - Visceral fat
    - Abdominal SAT
    - Pericardiac fat
    - Perivascular fat
  - o Increasing ("ectopic") fat deposition in other body organs:
    - Liver
    - Muscle
    - Pancreas
    - Heart
    - Kidney

14.2. Functional Changes [3,102]

Increased adipocyte hypertrophy and adipose tissue accumulation may contribute to:

- Adipocyte and adipose tissue hypoxia
- Increased adipose tissue immune cell infiltration
- Increased adipocyte apoptosis
- Increased reactive oxygen species and oxidative stress
- Extracellular matrix abnormalities
- Intraorganellar dysfunction (e.g., mitochondrial and endoplasmic reticulum stress)
- Changes in adipose tissue neural network and innervations

Adiposopathy most often results in metabolic disease when accompanied by:

- Dysfunction of other body organs
- Limitations of the metabolic "flexibility" of other body organs to mitigate the pathogenic metabolic, endocrine, and immune responses promoted by obesity

Metabolic health is dependent upon the interactions or crosstalk between adipose tissue and other body organs:

- Liver
- Muscle
- Pancreas

- Immune system
- Heart and vasculature
- Brain
- Endocrine glands
- Intestine
- Other body organs

14.3. Adiposopathic endocrinopathies and immunopathies

A variety of hormonal disruptions contribute to adiposopathic fat cell and fat tissue dysfunction. The adiposopathic consequences of obesity can adversely affect endocrine processes, leading to fat cell and fat tissue functional abnormalities that promote metabolic diseases. Adiposopathic endocrinopathies include disorders of [3,103–106]:

- Angiogenesis
- Adipogenesis
- Extracellular matrix dissolution and reformation
- Lipogenesis
- Growth factor production
- Glucose metabolism
- Production of factors associated with the renin-angiotensin system
- Lipid metabolism
- Enzyme production
- Hormone production
- Steroid metabolism
- Immune response
- Hemostasis
- Element binding (e.g., sterol regulatory element-binding proteins and calcium)
- Multiple receptors:
  - o Traditional peptides and glycoprotein hormones
  - o Nuclear hormones
  - o Cytokines or adipokines with cytokine-like activity
  - o Growth factors
  - o Catecholamine receptors

Table 7 describes the obesity-induced adiposopathic immunopathies that help promote metabolic diseases. Table 8 describes the metabolic manifestations of adiposopathy.

15. Sex-specific adverse consequences of obesity

15.1. Polycystic ovary syndrome (PCOS)

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder in females and occurs due to an imbalance of reproductive hormones in pre-menopausal females (with some metabolic abnormalities potentially extending into perimenopause) [114].

15.1.1. Signs and symptoms of PCOS

Potential signs and symptoms of PCOS include [114–116]:

- Irregular menses
- Infertility
- Hirsutism
- Acanthosis nigricans
- Alopecia
- Oily skin or acne

15.1.2. Other manifestations accompanying PCOS

PCOS can lead to many complications in addition to the common signs and symptoms listed above, including [114–116]:

- Excessive adiposity
- Inflammation
- Androgen excess
- Insulin resistance
- Non-alcoholic fatty liver disease
- Diabetes mellitus
- High blood pressure
- Dyslipidemia
- Metabolic syndrome
- Endometrial hyperplasia and neoplasia
- Depression, anxiety, bipolar disorders, bulimia, anorexia, other eating disorders (e.g., binge-eating disorder)
- Sleep apnea
- Miscarriage and premature birth

15.1.3. PCOS quick facts

- PCOS affects approximately 10% of females, with approximately 30% having first degree relatives with PCOS. This may be due to genetic, familial, racial, and/or ethnic predispositions [114,115].
- PCOS may be more common among Spanish, Native American, and Mexican females [116].
- PCOS may be more severe among females from South Asia (e.g., increased reproductive abnormalities, insulin resistance) [117].
- About 50% of females with PCOS have pre-obesity or obesity, suggesting that while increased adiposity may exacerbate PCOS, it is not the sole cause of PCOS [118].
- The proportion of females with PCOS who have hirsutism, hyperandrogenemia, or oligo-anovulation is approximately 10–20% for each [114].
- The proportion of females with PCOS who have polycystic ovaries is approximately 30% [114].
- The proportion of females with PCOS who have insulin resistance is over 50% [119].
- PCOS is a risk factor for [115,118]:
  - o Diabetes mellitus, hypertension, and dyslipidemia
  - o Non-alcoholic fatty liver disease
  - o Cardiovascular disease

15.1.4. Diagnosis of PCOS

PCOS can include a broad range of signs and symptoms, and diagnosis of PCOS involves ruling out other conditions as well as meeting the diagnostic criteria established by the Rotterdam consensus [114–116]:

- Rule out hypercortisolism, congenital adrenal hyperplasia, and androgen-secreting tumors.
- The Rotterdam consensus is two or more of the following:
  - o Hyperandrogenism (clinical or biochemical)
  - o Ovulatory dysfunction (menstrual irregularities)
  - o Polycystic ovary morphology by ultrasound (may not actually be "cysts," but rather antral follicles arrested in development)

15.2. Genitourinary manifestations and complications of obesity

Table 9 describes genitourinary manifestations of obesity in males related to "fat mass disease" and "sick fat disease." Table 10 describes genitourinary manifestations of obesity in females related to "fat mass disease" and "sick fat disease." Fig. 12 describes adiposopathic consequences of obesity leading to polycystic ovary syndrome. Table 11 describes polycystic ovary syndrome treatments. Table 12 describes sex-related genitourinary cancers with adiposopathic, obesity-promoted increased risks among both males and females.

16. Establishing an obesity medicine practice: standard operating procedures and telehealth

A common question among many clinicians is, "How do I start an obesity medicine practice?" The following is intended to serve as a

starting point outline (template) to consider in crafting obesity medicine standard operating procedures (SOPs). This is not a complete list, and not all items will apply to an individual obesity medicine practice. Fig. 13 and Tables 13–21 provide high-level topics to consider when starting an obesity medicine practice. Figs. 14–19 provide high-level overviews of considerations regarding incorporating telehealth ("ADAPT") in an obesity medicine practice.

17. Conclusions

This OMA CPS on obesity definition, diagnosis, bias, standard operating procedures (SOPs), and telehealth discusses basic principles regarding the definition, diagnosis, complications, and operating practices for an effective obesity medicine clinic and disease treatment. It is hoped that an understanding of the definition of obesity and its treatment principles may help clinicians better manage patients with obesity. Furthermore, it is hoped that the OMA recommendations on standard operating procedures and telehealth will aid clinicians in beginning and maintaining obesity medicine practices both in-person and virtually.

Transparency [138]

This manuscript was largely derived and edited from the 2021 Obesity Medicine Association (OMA) Obesity Algorithm. Beginning in 2013, OMA created and maintained an online Adult "Obesity Algorithm" (i.e., educational slides and eBook) that underwent yearly updates by OMA authors and was reviewed and approved annually by the OMA Board of Trustees. This was followed by a similar Pediatric "Obesity Algorithm," with updates ~ every two years by OMA authors. Authors of prior years' version of the Obesity Algorithm are included in Supplement #1.

Group composition

Over the years, the authors of the OMA Obesity Algorithm have represented a diverse range of clinicians, allied health professionals, clinical researchers, and academicians. (Supplement #1) The authors reflect a multidisciplinary and balanced group of experts in obesity science, patient evaluation, and clinical treatment.

Author contributions

HEB transcribed the first draft from the 2021 OMA Adult Obesity Algorithm. AKF and HEB then reviewed, edited, and approved the document for peer review by the OMA Board of Trustees.

Managing disclosures and dualities of interest

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Individual disclosures

AF has served as an advisor to Gelesis, NovoNordisk, Jenny Craig, Suvie, and MsMedicine. Since his 2021 appointment as Obesity Pillars Editor-in-Chief until time of publication, HEB has not served on any obesity-related promotional speakers' bureau. HEB's research site has received research grants from the following potentially applicable obesity-research related companies: Alon Medtech/Epitomee, Amgen, Boehringer Ingelheim, Eli Lilly, NovoNordisk, and Pfizer.

Evidence

The content of the OMA Obesity Algorithm and this manuscript is supported by citations, which are listed in the References section.

Ethics review

This OMA Clinical Practice Statement manuscript was peer-reviewed and approved by the OMA Board of Trustee members prior to publication. Edits were made in response to reviewer comments and the final revised manuscript was approved by all the authors prior to publication. This submission did not involve human test subjects or volunteers.

Conclusions and recommendations

This Clinical Practice Statement is intended to be an educational tool that incorporates the current medical science and the clinical experiences of obesity specialists. The intent is to better facilitate and improve the clinical care and management of patients with pre-obesity and obesity. This Clinical Practice Statement should not be interpreted as "rules" and/or directives regarding the medical care of an individual patient. The decision regarding the optimal care of the patient with pre-obesity and obesity is best reliant upon a patient-centered approach, managed by the clinician tasked with directing an individual treatment plan that is in the best interest of the individual patient.

Updating

It is anticipated that sections of this Clinical Practice Statement may require future updates. The timing of such an update will depend on decisions made by *Obesity Pillars* Editorial team, with input from the OMA members and OMA Board of Trustees.

Disclaimer and limitations

Both the OMA Obesity Algorithms and this Clinical Practice Statement were developed to assist health care professionals in providing care for patients with pre-obesity and obesity based upon the best available evidence. In areas regarding inconclusive or insufficient scientific evidence, the authors used their professional judgment. This Clinical Practice Statement is intended to represent the state of obesity medicine at the time of publication. Thus, this Clinical Practice Statement is not a substitute for maintaining awareness of emerging new science. Finally, decisions by practitioners to apply the principles in this Clinical Practice Statement are best made by considering local resources, individual patient circumstances, patient agreement, and knowledge of federal, state, and local laws and guidance.

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Appendix A. Supplementary data

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