Obstructive sleep apnoea (OSA) is a common disorder that has all the characteristics of a chronic condition. As with other chronic conditions, OSA requires ongoing management of treatments and problems, such as residual symptoms, deficits and co-morbidities. Also, many OSA patients have modifiable lifestyle factors that contribute to their disease, which could be improved with intervention. As health systems are in the process of developing more comprehensive chronic care structures and supports, tools such as chronic condition management programs are available to enable OSA patients and their health care providers to further engage and collaborate in health management. This review explains why the OSA patient group requires a more comprehensive approach to disease management, describes the chronic care model as a platform for management of chronic conditions, and assesses the suitability of particular chronic disease management programs in relation to the needs of the OSA population. Implementation of an evidence-based health-professional-led chronic condition management program into OSA patient care is likely to provide a context in which health risks are properly acknowledged and addressed. Such programs present an important opportunity to enable more optimal health outcomes than is possible by device-focused management alone.
Chronic disease characteristics of obstructive sleep apnoea

Characteristics of illnesses and health care requirements are shared across chronic conditions.\textsuperscript{11} As a disease which is prolonged, does not resolve spontaneously and is rarely completely cured,\textsuperscript{11} OSA matches the definition of a chronic illness. Chronic disease characteristics lead to health care requirements that are also shared across chronic conditions, including both ongoing clinical management and ongoing demands on the patient and their family.\textsuperscript{11} Multi-morbidity is prevalent in people with chronic conditions, increasing the need for and complexity of disease management for health care providers and patients.\textsuperscript{13} Common problems among OSA patients, which require ongoing chronic attention and management are reviewed below.

OSA and comorbidities

OSA patients often have multiple comorbidities, including\textsuperscript{8,9,13} cardiovascular disease and type 2 diabetes mellitus.\textsuperscript{8,13} Patients with multiple comorbidities face numerous challenges in managing their conditions, such as increasingly complex drug treatment regimes, a high volume of clinical encounters to remember and attend, and the cost of purchasing multiple drugs or treatment devices.\textsuperscript{14} A requirement therefore in comprehensive OSA management is coordination with disease management processes for other chronic conditions, often through the primary care physician.

OSA and mental health

Depression is an important and often underrecognised comorbidity to consider when treating OSA. Some studies have reported a prevalence of depression of between 21 and 41% in those with OSA.\textsuperscript{7,15} Furthermore, depression may be a significant contributor to EDS, independent of OSA. In a population-based study, Bixler and colleagues found that depression was the most significant risk factor for EDS followed, in decreasing levels of importance, by body mass index, age, typical sleep duration, diabetes, smoking, and finally obstructive sleep apnoea.\textsuperscript{15} Patients can be screened for evidence of depression using a validated screening tool such as the hospital anxiety and depression scale (HADS)\textsuperscript{16,17} and those found to have signs or symptoms of depression can be referred for further management. Given the overlap between mental health disorders and poor quality sleep, and the observation that EDS may be primarily influenced by depression, careful mental health assessment of all those who present with EDS is crucial.

Obesity – the most important risk factor for development of OSA

Obesity increases the severity of OSA.\textsuperscript{4} An 8 y population-based study with 690 subjects found that a 10% weight gain predicted a 32% increase in apnoea hypopnoea index (AHI) whilst a 10% weight loss predicted a 26% decrease in AHI.\textsuperscript{18} Rates of obesity have been rising relentlessly in both high and low income countries in recent years; in 2008, an estimated 1.46 billion adults worldwide were overweight (body-mass index [BMI] > 25 kg/m\textsuperscript{2}) and 502 million adults were obese (BMI > 30 kg/m\textsuperscript{2}).\textsuperscript{19} Obesity rates are expected to continue to climb,\textsuperscript{2} resulting in increased prevalence and severity of OSA.\textsuperscript{4} Additionally, Bixler and colleagues note that obesity itself may be associated with excessive daytime sleepiness (EDS) independent of OSA.\textsuperscript{15} EDS is one of the main presenting complaints in those who are referred to sleep medicine clinics.

A number of recent studies have examined the effects of weight loss in OSA patients.\textsuperscript{20–24} The study by Johansson et al. (n = 63) reported the greatest decrease in weight and OSA severity.\textsuperscript{21} The intervention group had a mean weight loss of 16.5% of their initial weight, with a concurrent decrease in their apnoea–hypopnoea index of 25 (p < 0.001), which represents a very substantial decrease in OSA severity, although this study also had the shortest follow up time (9 wk). Two year-long randomized controlled studies\textsuperscript{20,24} showed more modest changes in weight and AHI, although the Tuomilehto et al. study\textsuperscript{20} only included patients with mild OSA (AHI 5–15).

Bariatric surgical interventions have led to very significant improvements in OSA. A meta-analysis on bariatric surgery reported significant weight loss as a result of surgery and resolution of OSA in 85.7% of patients.\textsuperscript{22} However, there is often very limited public funding access to bariatric surgery and more effective changes in lifestyle are needed to control obesity at a population health level. Surgery will always be an adjunct rather than primary therapy for obesity management.

It is now being suggested that obesity itself be treated as a chronic condition\textsuperscript{26} with follow-up support contributing to maintenance of weight loss.\textsuperscript{27} Guidelines for obesity management consistently recommend a lifestyle approach to obesity management comprising dietary change, physical activity and behaviour change support as the first treatment step and the basis for any later measures such as drug or surgical treatments.\textsuperscript{28–30} Physical activity is often reduced in those with OSA, contributing to weight gain. Intriguingly, a recent study showed that exercise even in the absence of weight loss improved OSA.\textsuperscript{31} It is thus important to target these modifiable lifestyle factors as part of a comprehensive treatment approach in OSA management. Assisting patients to select from and access locally available weight loss information and support options would be an important part of chronic condition management for obese patients with OSA.

Alcohol intake and smoking are important modifiable risk factors for OSA

Alcohol, particularly in the last 2 h before bed-time, increases the duration and frequency of obstructive episodes, and hence worsens OSA.\textsuperscript{4,32–34} It may be beneficial to screen and counsel patients regarding alcohol use as part of a comprehensive chronic condition management program. Screening for alcohol risk level and dependency can be achieved using a validated screening test such as the four-question CAGE questionnaire, the title of which is an abbreviation of the key part of the four questions in the questionnaire relating to alcohol use (i.e., Cut down, Annoyed, Guilty, Eye-opener) or the ten-item alcohol use disorders identification test (AUDIT) tool.\textsuperscript{35–37} For those patients who consume slightly above low-risk levels, common guideline recommendations include providing the patient with brief interventions, including feedback to let them know that their level of drinking is of concern, gauging their readiness to change, providing advice to decrease levels, discussing strategies to help enable this to occur and/or providing referrals for further counselling.\textsuperscript{36,38} However, for those patients with moderate-to-severe alcohol problems or dependence, a more comprehensive assessment and referral to either specialised community or inpatient services would be required.\textsuperscript{39}

Smoking also worsens OSA, in a dose-responsive pattern.\textsuperscript{5,40} As part of a chronic condition management program, smokers can be referred to a health practitioner who can provide advice on quitting and relapse prevention, pharmacotherapy and more intensive counselling services in accordance with locally applicable clinical practice guidelines.\textsuperscript{42–44}
CPAP a gold standard therapy for OSA with variable, often suboptimal adherence

Continuous positive airway pressure (CPAP) is the gold standard treatment for moderate–severe OSA, significantly reducing the apnoea hypopnoea index. However, some residual symptoms and deficits remain even among those optimally treated with CPAP. A key remaining symptom is EDS. One multicentre study of 174 patients treated with CPAP found that 40% of moderate/severe OSA patients still had an abnormal Epworth Sleepiness Scale (ESS) score after three months of CPAP treatment. Of the patients with optimal CPAP adherence (>6 h per night), 36% of patients with an abnormal ESS failed to achieve a normal ESS score hours/night after 3 mo of treatment and >50% of patients with abnormal baseline functional outcome of sleep questionnaire (FOSQ) scores failed to normalise their scores. Very similar results were reported by Weaver and colleagues in 2007, where they noted that even amongst OSA patients using CPAP for >7 h per night at 3 mo, only 30% of patients normalised their multiple sleep latency (MSLT) test results and only 50% normalised their FOSQ results.

This residual EDS may have various aetiologies such as: disruption to sleep caused by CPAP itself; insufficient use of CPAP; other sleep disorders not responsive to CPAP; co-existent mood disorders; sedating medications; obesity; advanced age; insufficient sleep duration; diabetes; smoking or hypoxic brain injury from chronic OSA. Depression is a particularly important comorbidity to consider when treating OSA, given the overlap between symptoms and the strong association between the two. As noted earlier, in a population-based study, Bixler and colleagues found that depression was the most significant risk factor for EDS. The same group has noted that obesity itself may be associated with EDS independent of OSA. Their report is a reminder that there are many causes of EDS. A broader approach to the recognition, diagnosis and management of EDS is warranted and should be part of chronic condition management in OSA.

Some neurocognitive deficits also remain with CPAP use. Antic et al. found that verbal memory and executive function tests showed significant improvement after 3 mo of CPAP (all p < 0.001), but vigilance was not significantly improved. Zimmerman and colleagues reported a similar finding with verbal memory. They found a dose–response relationship between the level of CPAP adherence and the extent of improvement in verbal memory scores after 3 mo amongst 58 memory-impaired OSA patients, but approximately one third of patients who had CPAP adherence levels greater than 6 h per night failed to normalise their verbal memory scores. Again, a broader chronic condition management plan can address these residual deficits and provide further strategies to manage the symptoms that remain despite CPAP use.

There are well-documented problems with adherence to CPAP therapy. CPAP adherence occurs at a rate of 29–83% when adherence is defined as at least 4 h of use per night. Given that CPAP is an effective therapy for moderate/severe OSA, maximising adherence is an important component of any OSA treatment program, particularly as it is highly likely that inadequate CPAP adherence contributes to some of the residual EDS seen in OSA patients treated with CPAP. Behavioural strategies are likely to be more cost-effective than improving CPAP adherence using more expensive CPAP modalities but there is insufficient data regarding which education and support is most effective and the best way of delivering such assistance. Educational or psychological strategies are, however, thought to be most effective if provided to patients prior to initiation of CPAP, since many patients refuse to consider CPAP or drop out after initial exposure to therapy. The challenges of maintaining long term CPAP adherence for patients mean that somewhat uniquely, the therapy itself for OSA requires a chronic care approach to maintain adequate adherence to the therapy. A chronic condition management approach would encompass behavioural strategies at the initiation of therapy and would explore alternatives to CPAP if necessary.

In summary, there are many disease management issues for patients with OSA, including: residual EDS and neurocognitive deficits despite CPAP therapy; adherence problems associated with CPAP use; lifestyle factors known to contribute to OSA severity; multiple comorbidities; and socioeconomic problems. All of these disease management issues are ideally placed to be addressed as part of a comprehensive chronic condition management program. Table 1 provides a summary of potential interventions for OSA patients, in order to address their disease management issues, as part of a chronic condition management program.

### The chronic care model

The chronic care model has been accepted and adapted internationally as a conceptual model to re-organise patient care to meet the needs of people with chronic illness. The model comprises six interacting components: 1) health care organisation that facilitates and promotes chronic disease management; 2) community resources linking patients to additional services and resources; 3) self-management support which collaboratively helps patients to acquire the skills and confidence to manage their conditions; 4) a delivery system featuring planned visits and practice teams with delineated roles to manage chronic conditions separately from acute care; 5) decision support providing reminders on evidence-based treatments, access to specialist expertise and educational interventions.

#### Table 1

<table>
<thead>
<tr>
<th>Potential interventions as part of a chronic condition management program for obstructive sleep apnoea patients.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carbohydrate disease, type 2 diabetes &amp; other medical co-morbidities</strong></td>
</tr>
<tr>
<td><strong>Depression</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Obesity</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Excessive alcohol intake</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Smoking</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Residual sleepiness and neurocognitive deficits despite CPAP treatment</strong></td>
</tr>
<tr>
<td><strong>Poor CPAP adherence</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AUDIT, alcohol use disorders identification; CPAP, continuous positive airway pressure; HADS, hospital anxiety and depression scale; OSA, obstructive sleep apnoea.
sessions; and 6) clinical information systems providing reminder flags on evidence based treatments, performance feedback and registry-type data about individual patients and populations. The model remains an aspiration for most health services, with implementation still patchy and partial. \(^{37,58}\) Also, the model has not yet been well detailed or tested for patients with multiple morbidities \(^{12,59}\) or for use in specialist care. \(^{50}\) However, progress to date has produced tools for self-management support and collaborative care planning which are consistent with the chronic care model and these can be assessed for use in OSA.

The important role of self-management support in the chronic care model is justified by the recognition that patients themselves and their families are the primary caregivers in chronic illness. It is patients who decide on a day-to-day basis whether and how to implement treatments and health related behaviours as directed or recommended by health professionals. \(^{61,62}\) Providing medical information to patients does not reliably bring their self-management decision-making into line with physician instructions, evidenced in OSA by problems with adherence to CPAP and advice on alcohol and tobacco use. Self-management support instead includes bringing patient-identified problems and goals into care planning alongside physician-identified issues and part the collaboration which engages patient and family members as well as physicians and other health care providers. \(^{61-63}\) Tools for comprehensive disease management in OSA should therefore allow for self-management support with collaborative care planning.

### Types of chronic condition management programs

Chronic condition management programs come in many varieties, with differing efficacies and applicability to patient groups. \(^{64,65}\) Apart from differences in program length, setting (rural versus urban) and available resources, these programs can vary based on 1) leadership in the programs (peer-led versus health-professional led); 2) whether they are targeted at specific conditions (“disease-specific”) or applicable across conditions and for management of multiple conditions (“generic”); 3) group versus individual programs and 4) mode of delivery (face-to-face versus programs using communication technologies). The comparative effectiveness of different ways of communicating with patients for these programs (e.g., group or individual and face-to-face or using communication technologies) is still to be determined. \(^{66,67}\) The discussion that follows deals in more detail with peer-led and health-care professional led programs and addresses the suitability of disease specific and generic approaches for OSA.

### Peer-led chronic condition programs

Some chronic condition management programs are led by people who have chronic conditions themselves (peer or lay-led). The best known example of a peer-led program is the Stanford University chronic disease self-management program (Stanford program), a generic community-based, peer-led patient self-management education workshop, which was developed in the 1990s. \(^{68}\) This six-week program consists of a weekly 2.5 h workshop in community settings where people with different chronic health problems attend together. Workshops are facilitated by leaders, who have chronic diseases themselves and are trained and credentialed to deliver the Stanford program, with no requirement for any health-related background or training. Some of the claimed advantages of this program are that, being peer-led, it is likely to be relevant to the lived experiences of patients, with the focus on problem solving and goal setting from a peer perspective rather than a health professional perspective. \(^{64}\) However, the Stanford program and other peer-led programs have been shown to have small benefits with no impact on quality of life or service use and evidence on any long-term benefits is lacking. \(^{69,70}\) There are also problems with recruitment and retention of patients as programs primarily recruit women from higher socio-economic backgrounds. \(^{70}\)

Peer-led programs, such as the Stanford program, are therefore unlikely to be adequate for the needs of OSA patients, especially as a stand-alone program. Furthermore, the program has no impact on the behaviour of health professionals and the culture, structure and accountability of health services regarding their patients. \(^{64}\)

### Health-professional led programs, disease specific

Health profession-led programs are usually disease-specific and may have some advantages over peer-led programs, including the ability to influence health-professional behaviour and the culture of health services. \(^{64}\) Programs aimed at asthma, \(^{71}\) diabetes \(^{72}\) and arthritis \(^{73}\) have been studied. Meta-analyses have shown clinically important benefits in hypertension and diabetes mellitus. \(^{74,75}\) Although the current evidence base suffers from possible publication bias and variable study quality, \(^{74}\) disease specific programs may not suit older patients or those with multiple chronic illnesses \(^{76}\) such as many people who have OSA. \(^{8,13}\) Although there are many programs targeting adherence to CPAP, there appear to be no genuine self-management program specifically targeted at the disorder of OSA and its co-morbidities.

### Health-professional led programs, generic

Because underlying self-management requirements are applicable across conditions \(^{63}\) and because patients are usually managing several conditions and risk factors, \(^{77}\) there are also general programs delivered by health professionals. These are used as alternatives or additions to disease-specific programs. The Flinders program of chronic condition management (Flinders program) is a well-recognised generic health-professional-led chronic condition management program \(^{64,78}\) which has been associated with improved health outcomes in several studies. \(^{79-82}\) It structures the health practitioner’s engagement with patients to assess self-management behaviours, identify problems and set goals in order to work towards improved condition management. It is based on principles of cognitive behavioural theory and motivational interviewing and is designed to act as a motivational tool for patients to increase engagement in their own care. \(^{84}\) The program allows multiple co-morbidities to be addressed simultaneously and assists in the linkage of patients with community services, for example where lifestyle factors need to be addressed. \(^{84}\) This is particularly useful for the OSA patient population, who often have multiple comorbidities and risk factors. \(^{8,13}\)

The Flinders program is also adaptable, \(^{64,81}\) and has been used successfully in a wide range of conditions including diabetes, \(^{81}\) mental health problems, \(^{82}\) arthritis \(^{79}\) and stroke. \(^{83}\) It is thus likely that it could be relatively easily adapted also for use in obstructive sleep apnoea.

### Health literacy in OSA

Health literacy is a term which has been used to cover a range of abilities including the ability to read, write and understand health-related information to make sound health-related decisions and to navigate life in a way that promotes good health. It encompasses a range of attributes and skills, including the ability to know when and where to seek health information, good verbal communication
skills, assertiveness and the ability to retain and apply information. A recent national survey indicated that around 60% of adults lacked the health literacy skills to cope with the demands of modern health care and to make the decisions required to manage their health. At a clinical level, there is evidence that tailoring communication to those with poor health literacy can improve outcomes.

Health literacy issues may directly affect a person’s ability to care for sleep disorders and also the clinical teams’ ability to assist patients effectively. A recent review called “further research to investigate the prevalence and impact of low health literacy in patients with sleep disorders”. Although there is little research on OSA and health literacy, one report found that one-third of patients had difficulty understanding and completing the Epworth sleepiness scale, the standard measure of excessive sleepiness. Taking health literacy into account when designing interventions for management of OSA may be crucial in improving outcomes.

Conclusion

In conclusion, obstructive sleep apnoea has all the characteristics of a chronic illness. In OSA, as with other chronic conditions, ongoing management of treatments and problems such as residual symptoms, deficits and co-morbidities is required. Also, many patients have modifiable lifestyle factors contributing to their disease, which could be improved with intervention. While health systems are still developing comprehensive chronic care structures and supports, tools such as chronic condition management programs are available to help further engage OSA patients and health care providers in management of the patient’s health. Incorporating tools such as a health-professional-led chronic condition management program into patient care could provide the context where health risks are properly acknowledged, for the first time for many patients, and a unique opportunity to influence a variety of risk factors for chronic conditions as part of the consultation (such as obesity, vascular risk, excessive alcohol consumption, mental health issues). If sleep medicine services don’t deal with these issues in a logical and evidence based way, this opportunity will be lost.

Furthermore, if the field of sleep medicine remains so device-focused when treating patients with OSA and does not evolve chronic disease management programs into the care pathways of those with OSA, patient outcomes are likely to remain suboptimal.

Research agenda

In order to enhance and improve OSA patient care and outcomes in the context of chronic condition management, the following steps should be undertaken:

1) The efficacy of health-professional led chronic condition management programs for OSA patients should be measured using well-designed randomised controlled trials.
2) The opinions of OSA patients and health care providers that participate in such trials should be sought via qualitative interviews, with results being used to enhance the programs.
3) Implementation of the selected program into patient care may be initiated and studied.
4) Ongoing review of the programs in the context of developing chronic condition structures and supports in existing health systems should occur.

References


* The most important references are denoted by an asterisk.


