Screening for obstructive sleep apnoea in cardiac rehabilitation: A position statement from the Australian Centre for Heart Health and the Australian Cardiovascular Health and Rehabilitation Association

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Abstract
Obstructive sleep apnoea is highly prevalent in acute coronary syndrome patients eligible for enrolment in cardiac rehabilitation programmes. This condition is an independent predictor of increased morbidity and comorbid conditions in the general population and can lead to an increase in major adverse cardiac events such as revascularization, heart failure and hospital readmission in cardiac patients. There is convincing evidence that treatments such as continuous positive airway pressure or mandibular advancement devices can successfully treat obstructive sleep apnoea and these conditions can be improved or negated resulting in improved cardiac rehabilitation outcomes and improved health related quality of life. Given the potential benefits of obstructive sleep apnoea treatment it would make sense to screen for this condition upon entry to out-patient cardiac rehabilitation programmes. A two-stage approach to screening is recommended, where patients are initially evaluated for the probability of having obstructive sleep apnoea using a brief questionnaire (The STOP-Bang) and then followed up with objective evaluation (portable home monitor or polysomnography) where necessary. Potential barriers to further referral and treatment could be partly mitigated by the training of cardiac rehabilitation staff in sleep disorders and screening.

Keywords
Obstructive sleep apnoea, cardiac rehabilitation, screening

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Definitions and scope of position paper
This position paper presents the views of an expert panel represented by members of the Australian Centre for Heart Health and the Australian Cardiovascular Health and Rehabilitation Association.

Obstructive sleep apnoea (OSA) is characterized by recurrent episodes of complete or partial upper-airway obstruction during sleep due to the collapse of upper-pharyngeal soft tissue during sleep, resulting in intermittent oxygen deprivation, usually unrecognized by the patient. An apnoea is a cessation of airflow lasting 10 seconds or longer and is often associated with oxygen desaturation, whereas a lesser reduction in

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airflow is termed a hypopnoea. The severity of OSA is commonly quantified by the apnoea–hypopnoea index (AHI), which is the average number of apnoeic and hypopnoeic events per hour. An AHI of 5–15 indicates mild OSA, 15–30 indicates moderate OSA and >30 indicates severe OSA.3

The International Classification of Sleep Disorders – third edition4 describes seven major types of sleep disorders, including the sub-category of ‘sleep-related breathing disorders’, which includes OSA. The latest diagnostic statistical manual (DSM-V)5 includes three sub-types of ‘breathing-related sleep disorders’: OSA, primary central sleep apnoea (CSA) and sleep-related hypoventilation. It is known that CSA is highly prevalent in congestive heart failure6 and atrial fibrillation7 patients and implications for screening and treatment will be different in these patients and are beyond the scope of this paper. While other types of sleep–wake disorders such as insomnia are known to affect cardiac patients in general,8 the primary focus of the current position paper will be on screening for OSA in acute coronary syndrome (ACS) patients who are eligible to attend outpatient cardiac rehabilitation programmes.

**Estimated prevalence of OSA in ACS patients entering cardiac rehabilitation programmes**

The expert panel believes that the prevalence of OSA in ACS patients is substantially higher than the general population and is largely under-recognized in patients commencing cardiac rehabilitation programmes.

Prevalence rates of OSA in ACS patients is thought to be much higher than that experienced in the general population. Studies that have used screening questionnaires such as the Berlin Questionnaire or STOP-Bang to estimate the probability of a patient having OSA suggest that the prevalence of OSA in ACS patients ranges from 44% in a sample of patients commencing a cardiac rehabilitation programme10 to a high of 82% in patients admitted for coronary angiography.11 Studies that have used objective measures such as polysomnography (PSG) or portable home monitoring have confirmed that up to three-quarters of ACS patients have at least mild (AHI ≥ 5) OSA, and close to a half have moderate or severe (AHI ≥ 15) OSA. Much of the variability in prevalence estimations is due to variations in timing of the assessment (pre-procedure, post-procedure, recovery or long-term follow-up) and the variability in portable home monitoring equipment.12 It is known that many portable monitors may underestimate OSA severity because they use total recording time instead of total sleep time as a denominator in the calculation of AHI,13 and the actual severity of OSA may be even higher than reported.14 If we focus on those studies that have used the gold standard for sleep assessment, PSG, the pre-operative prevalence for moderate to severe OSA (AHI ≥ 15) in coronary artery bypass graft (CABG) surgery patients is at least 50%15,16 and 46% in percutaneous coronary intervention (PCI) patients.17 In the post-discharge period and following weeks when patients are expected to attend cardiac rehabilitation, estimation of moderate to severe OSA via PSG ranges from 52%18 (PCI patients) to 64%19 (PCI and CABG patients). A conservative estimate, therefore, is that close to half of all patients commencing cardiac rehabilitation programmes may potentially have moderate to severe OSA and close to two-thirds may have mild OSA.

**Why screen for OSA?**

The expert panel believes that there are two major reasons why all patients attending cardiac rehabilitation should be screened for the diagnosis of OSA: (1) the negative impact of OSA on the health and recovery of cardiac patients and (2) evidence demonstrating the positive effects following treatment of OSA.

There is increasing evidence that failure to manage sleep problems in cardiac patients can affect postoperative recovery and also influence morbidity, mortality and the quality of life. Cardiac patients with untreated OSA may also experience a significantly worse outcome during and after their cardiac rehabilitation. It is thought that patients with OSA have daytime sleepiness and fatigue and therefore reduced physical activity, and find it more difficult to lose weight than those without OSA. It has been demonstrated that cardiac rehabilitation participants with symptoms of excessive daytime sleepiness have decreased functional capacity as indicated by significantly lower six minute walk test results.24 Further, OSA patients may not be capable of burning sufficiently high levels of oxygen during strenuous aerobic exercise25 and also have reduced diastolic function,26 which is a diagnostic marker for heart failure. There is also evidence that sleep disorders are associated with decreased treatment adherence and self-efficacy,27 which in turn may have a detrimental impact on cardiac rehabilitation efforts and long term prognosis. The association of OSA with depression in cardiac patients20,28 is particularly concerning given the known deleterious effect of depression on treatment adherence and completion of cardiac rehabilitation.29 Long term consequences of untreated OSA are also beginning to emerge. In a follow-up study (mean 4.5 years) of CABG patients, after adjustment for potential confounders such as body mass index, untreated OSA was associated with significantly more major adverse
cardiac or cerebrovascular events, new revascularizations, angina episodes and atrial fibrillation. The deleterious effects of untreated OSA on long-term major cardiac events are apparent as early as six months post-procedure as demonstrated in ACS patients treated by PCI.

Perhaps the most convincing argument for screening for OSA in cardiac patients is the benefits that emerge once OSA is treated. Treating OSA with continuous positive airway pressure (CPAP) has been shown to improve serum markers of cardiac and vascular injury, and improve plasma levels of nitric oxide derivatives. Recently, CPAP treatment in cardiac patients has been shown to significantly reduce levels of prohormone brain natriuretic peptide, a gold standard biomarker for heart failure. Finally, studies with cardiac patients have shown long term benefits with significant reductions in major adverse cardiac events and reductions in cardiac deaths after treatment with CPAP compared with those who remain untreated.

**When should patients be screened for OSA?**

The expert panel believes that the optimal timing for screening for OSA is upon entry to out-patient CR programmes.

It is possible to assess sleeping patterns and OSA preoperatively, postoperatively while the patient is hospitalized, or in the post-hospitalization period when patients are referred to cardiac rehabilitation programmes. Although the preoperative period has been advocated as an opportune time for OSA screening, it is not always possible to assess patients preoperatively particularly if the procedure is an emergency one. Further, even if the procedure is elective, the preoperative sleep phase may not be considered an accurate representation of baseline habitual sleep because of the stress of anticipating the cardiac surgical procedure. It is also well known that cardiac patients experience sleep deprivation during hospitalization after cardiac surgery due to physiological factors, medication side-effects, pain, discomfort, environmental noise in the hospital and insomnia. Assessment during this turbulent phase of recovery would therefore be impractical and not advised. There is some evidence that patients recruited at early phase cardiac rehabilitation (usually inpatient programmes) may suffer transient OSA due to fluid redistribution as the patient moves from the upright to recumbent position, and then back to the upright position as the patient recovers. The optimal time to assess for OSA may be at the commencement of out-patient cardiac rehabilitation, which is typically four to six weeks following surgery.

**Recommended screening instrument**

The expert panel believes that simple to use, but reliable and valid screening tools, such as the STOP-Bang, should be administered as part of routine screening of patients entering cardiac rehabilitation programmes.

Given the expected high prevalence rates of OSA in cardiac patients it would be impractical to assess every patient in a sleep laboratory using PSG. Therefore, a screening tool is necessary to stratify patients based on their clinical symptoms, their physical characteristics and their risk factors, in order to ascertain patients at high risk and in urgent need of PSG and/or further treatment such as CPAP and patients at low risk who may not need PSG and immediate treatment. While there are promising indications that unobtrusive portable objective instruments such as the Watch-PAT may be a useful alternative to PSG in cardiac rehabilitation patients, more studies are required to assess the validity of such devices in this population. At present, questionnaires can be appropriate tools for quick prediction of OSA as they can be applied and scored easily as part of routine daily practice. It can be argued that the cardiac rehabilitation setting is an optimal setting for this screening because it is easy to screen in this setting and patients may be more receptive to screening after having suffered a potentially life altering event.

The selection of appropriate screening instruments for cardiac patients should not rely solely upon validation studies conducted with the general population or general surgical population. There is evidence that cardiac patients differ substantially in their sleeping patterns from non-cardiac surgical matched controls and the general population. For example, in one study PSG confirmed that CABG patients sleep less than matched abdominal surgery patients and do not necessarily experience excessive daytime sleepiness if they are confirmed to have OSA. Other studies with CABG patients, ACS patients, PCI patients and cardiac rehabilitation participants have confirmed this discrepancy between lack of daytime sleepiness and confirmed OSA. A commonly used tool to assess symptoms of OSA in the general population, the Epworth Sleepiness Scale (ESS) is therefore not recommended as an accurate screening tool for cardiac patients because of its specific focus on daytime sleepiness as a marker of sleep disturbance.

Apart from ease of use there are four psychometric indicators that should be taken into account in order to assess suitability of a screening instrument for OSA. The sensitivity of a clinical test refers to the ability of the test to correctly identify those patients with the condition. The specificity of a clinical test refers to...
the ability of the test to correctly identify those patients without the condition. The positive predictive value (PPV) of a test is a proportion that is useful to clinicians since it answers the question: ‘How likely is it that this patient has the condition given that the test result is positive?’ The PPV of a screening test will be influenced not only by the sensitivity and specificity of the test, but also by the prevalence of the condition in the population that is being screened. As the condition or disease becomes more prevalent, subjects are more frequently in the ‘affected’ or ‘diseased’ column, so the probability of disease among subjects with positive tests will be higher. Choosing a lower diagnostic cut-point may also increase the PPV. For OSA, we would expect the PPV values to be larger if we consider a lower AHI cut-point. For example AHI > 5, the prevalence is 67%, for AHI > 15 the prevalence is approximately 50%. Finally, the negative predictive value (NPV) reflects the probability that subjects with a negative screening test truly do not have the disease. In summary, a test will perform close to the ‘gold standard’ if the PPV and NPV are as close to 100% as possible.

The number of studies comparing the performance of OSA screening questionnaires on these four psychometric indicators is limited. In a large population study, the Sleep Heart Health Study, the STOP-Bang questionnaire had the highest sensitivity for moderate-to-severe (87.0%) and severe OSA (70.4%) in comparison with the ESS and the STOP questionnaire. The high sensitivity of the STOP-Bang was confirmed in a non-surgical population comparison of four instruments (Berlin, ESS, STOP and STOP-Bang), showing that the STOP-Bang was best at correctly identifying participants at risk with mild, moderate or severe OSA (97% sensitivity). However, the STOP-Bang had high PPV but modest NPV and could not accurately exclude those at low risk (26% specificity). Similarly with pre-operative general surgical patients, Chung et al. found that the STOP-Bang questionnaire had high sensitivity for detecting OSA for moderate and severe OSA (93% and 100%, respectively), yet high false-positive rates was still a problem with specificity still low: 47% and 37% for moderate and severe OSA, respectively. An evaluation of screening questionnaires in pre-operative CABG patients also confirmed high sensitivity and low specificity of the STOP-Bang questionnaire in comparison with other questionnaires. A recent study with primary care patients demonstrated that very high specificity could be obtained when the STOP-Bang cut-off was increased to > 6/8 (96% specificity). This confirms that there is very little chance of false-positives if scores higher than 6 are obtained on the STOP-Bang. The area under the receiver operating characteristics curve for the ability of the STOP-Bang to predict an AHI above 5, 15, and 30 events/h ranged from 0.78 to 0.82, which is more favourable compared with the previously recommended Berlin questionnaire (0.67 to 0.69). Finally, a systematic review of screening questionnaires for OSA in surgical patients has recommended the STOP-Bang instrument in preference to the Berlin Questionnaire and other available instruments. It has been argued that in community populations, high specificities and NPV may be more useful in excluding low-risk patients, while avoiding false-positives. However, in order to avoid missing cases that may lead to adverse health consequences, poorer adherence to cardiac rehabilitation and increased healthcare costs it may be preferable to use screening tools with high sensitivities and PPV, like the STOP-Bang.

A summary of commonly used instruments used to assess OSA in general surgical patients is presented in Table 1. Usage of the ESS or Pittsburgh Sleep Quality Index (PSQI) to screen for OSA is an example of using a tool for a purpose for which it was not intended. The ESS was designed to assess daytime sleepiness and cannot distinguish simple snorers from patients with OSA. The PSQI was designed as a general measure of disturbed sleep and has poor diagnostic accuracy to predict specific conditions such as OSA. Of all the existing sleep screening questionnaires, the STOP-Bang is the most recommended screening tool due to the ease of administration, high sensitivity and the fact that it has been developed for OSA screening in the clinical and surgical population. We therefore recommend that the STOP-Bang be administered as part of routine screening of patients entering cardiac rehabilitation programmes.

**Referral pathways and treatment**

The expert panel believes that a two-stage process of screening for OSA in cardiac rehabilitation patients could be implemented. This would involve questionnaire administration followed by objective assessment if scores indicate high probability of OSA. The panel further believes that treatment must involve patient preferences for either CPAP or mandibular advancement devices, which should be taken into account in order to achieve higher compliance to treatment.

Until relatively recently, specific guidelines regarding sleep disorders were absent from all major cardiac rehabilitation policy providers. In 2008 the American Heart Association produced an expert consensus statement detailing the relevance of OSA to patients with cardiovascular disease. That statement called for more research into non-invasive screening methodologies that are less expensive and more widely applicable than full PSG. The Canadian Association of Cardiovascular Prevention and Rehabilitation 2009 guidelines specifically state that all cardiac
<table>
<thead>
<tr>
<th>Instrument</th>
<th>No. of items</th>
<th>Admin mode/ease of use</th>
<th>Purpose</th>
<th>Predictive values for detection of OSA (AHI &gt; 15) in surgical or cardiac patients</th>
<th>Validated or used with cardiac patients (see notes for patient characteristics)</th>
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<tbody>
<tr>
<td>Berlin Questionnaire</td>
<td>49</td>
<td>Self/easy to use, difficult to score</td>
<td>Designed to diagnose OSA in primary care and surgical patients</td>
<td>Sensitivity 67%&lt;sup&gt;15&lt;/sup&gt; Specificity 26% PPV 50% NPV 42%</td>
<td>Yes – good validity Was instrument of choice before STOP-Bang Sert-Kuniyoshi et al. 2011&lt;sup&gt;a&lt;/sup&gt; Nunes et al. 2015&lt;sup&gt;b&lt;/sup&gt; Mahmoud et al. 2014&lt;sup&gt;c&lt;/sup&gt; Loo et al. 2014&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>STOP&lt;sup&gt;46&lt;/sup&gt;</td>
<td>4</td>
<td>Self/easy to use and score</td>
<td>Designed to diagnose OSA in surgical patients</td>
<td>Sensitivity 74%&lt;sup&gt;16&lt;/sup&gt; Specificity 53% PPV 51% NPV 76%</td>
<td>Yes – good validity Nunes et al. 2015&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>STOP-Bang&lt;sup&gt;52,53&lt;/sup&gt;</td>
<td>8</td>
<td>Clinician/easy to use and score</td>
<td>Designed to diagnose OSA in surgical patients. Improves upon STOP by incorporating BMI, age, neck size and gender</td>
<td>Sensitivity 94%&lt;sup&gt;15&lt;/sup&gt; Specificity 13% PPV 43% NPV 75%</td>
<td>Yes – good validity and beginning to be used in many studies with cardiac patients Wali et al. 2015&lt;sup&gt;e&lt;/sup&gt; Nunes et al. 2015&lt;sup&gt;b&lt;/sup&gt; Mahmoud et al. 2014&lt;sup&gt;f&lt;/sup&gt;</td>
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<td>ASA checklist&lt;sup&gt;55&lt;/sup&gt;</td>
<td>14</td>
<td>Clinician/clinician required to score</td>
<td>Designed to diagnose OSA in surgical patients. Designed for anesthesiologists to administer</td>
<td>Sensitivity 79%&lt;sup&gt;16&lt;/sup&gt; Specificity 37% PPV 45% NPV 73%</td>
<td>Has lower validity than STOP-Bang Mahmoud et al. 2014&lt;sup&gt;f&lt;/sup&gt;</td>
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<tr>
<td>Sleep Apnea Clinical Score&lt;sup&gt;57&lt;/sup&gt;</td>
<td></td>
<td>Clinician/clinician required to score</td>
<td>Designed to assess probability of perioperative sleep disordered breathing. Designed for anesthesiologists to administer</td>
<td>Sensitivity 35%&lt;sup&gt;18&lt;/sup&gt; Specificity 78% PPV 77% NPV 35%</td>
<td>No – not used in some general surgical studies not specifically involving cardiac patients</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale&lt;sup&gt;59&lt;/sup&gt;</td>
<td>8</td>
<td>Self/easy to use and score</td>
<td>Not designed to diagnose OSA. Assessment of daytime sleepiness</td>
<td>Sensitivity 37%&lt;sup&gt;50&lt;/sup&gt; Specificity 76% PPV 60% NPV 56%</td>
<td>Not validated in cardiac patients but used in many studies with cardiac patients Skobel et al. 2014&lt;sup&gt;43&lt;/sup&gt; Mahmoud et al. 2014&lt;sup&gt;40&lt;/sup&gt;</td>
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<td>Pittsburgh Sleep Quality Index&lt;sup&gt;61&lt;/sup&gt;</td>
<td>19</td>
<td>Self/easy to use and score</td>
<td>Not designed to diagnose OSA. Assessment of overall sleep quality. Discrimination between good and poor sleepers. Assessment of multiple sleep disturbances. Partner observations included</td>
<td>Sensitivity 69%&lt;sup&gt;50&lt;/sup&gt; Specificity 31% PPV 48% NPV 52%</td>
<td>Not validated in cardiac patients. Used in some studies with cardiac patients</td>
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<sup>a</sup> Patients, N = 383, enrolled in early outpatient cardiac rehabilitation, mean age = 63 years.  
<sup>b</sup> Patients, N = 40, referred for coronary artery bypass graft surgery, aged 40–70 years, body mass index < 40 kg/m².  
<sup>c</sup> Patients, N = 60, with cardiovascular disease.  
<sup>d</sup> Percutaneous coronary intervention patients, N = 1358, aged 18–80 years.  
<sup>e</sup> Coronary artery disease patients, N = 156, mean age = 57 years (high risk), 47 years (low risk), mean body mass index = 31 kg/m² (high risk), 25 kg/m² (low risk).  
<sup>f</sup> Patients, N = 1152, enrolled in early outpatient cardiac rehabilitation, mean age = 60 years, mean body mass index = 28 kg/m².  
OSA: obstructive sleep apnoea; AHI: apnoea–hypopnoea index; PPV: positive predictive value; NPV: negative predictive value; ASA: American Society of Anesthesiologists
rehabilitation patients should be screened for potential sleep disorders with a validated screening instrument.\textsuperscript{65} The 2012 European Guidelines on cardiovascular disease prevention in clinical practice posit that there is strong evidence that all persons with OSA should undergo medical assessment, including risk stratification and risk management.\textsuperscript{66} We concur with these existing guidelines and reviews that recognize the importance of identifying sleep disorders in cardiac rehabilitation programmes.\textsuperscript{67} The high prevalence of OSA in cardiac patients and the deleterious consequences of untreated disease demand that optimal organizational models of care are identified and implemented.

A suggested OSA screening algorithm for patients attending cardiac rehabilitation programmes is presented in Figure 1. Risk classification for OSA will be determined by the incorporation of the STOP-Bang questionnaire\textsuperscript{52,53} administered upon entry to cardiac rehabilitation. Cardiac rehabilitation staff could be easily trained to score the STOP-Bang and identify patients at high risk. If a patient scores 0 to 2 on the STOP-Bang questionnaire, he or she is very unlikely to have moderate-to-severe OSA and there is no need for objective evaluation. It has also been suggested that if a patient scores higher than 5 on the STOP-Bang they almost certainly have OSA and there is no need for further diagnosis by objective measures such as

\textbf{Figure 1.} OSA screening algorithm for patients attending cardiac rehabilitation programmes. OSA: obstructive sleep apnoea; CR: cardiac rehabilitation; AHI: apnoea–hypopnoea index; CPAP: continuous positive airway pressure.
PSG. \(^5\)2, 53 If we adopt a more conservative approach, all patients who are at medium risk (STOP-Bang > 2) or high risk (＞5) can be referred for portable home monitoring, if available, or PSG (via referral by family physician) for confirmation of OSA diagnosis. Community studies have found that a two-stage model of care, using a screening questionnaire followed by home portable monitoring, was not inferior to a more complex model of care which involved sleep specialists and PSG. \(^6\)8, 69 If the objective assessment confirms at least moderate or severe OSA (AHI) then patients can be referred for treatment. The sleep specialist will determine which treatment modality (e.g. CPAP, mandibular advancement splint) will best suit the individual. A recent meta-analysis confirmed that mandibular advancement devices are just as effective as CPAP in lowering blood pressure. \(^7\)0 It is the patient preferences for treatment \(^7\)1 and resulting compliance \(^7\)2 that is the more important factor in determining the success of treatment. Towards the completion of the cardiac rehabilitation programme the STOP-Bang could be readministered in order to check if the patient is still at risk of OSA following cardiac rehabilitation risk factor management.

**Challenges**

The expert panel believes that further research is necessary into the practical implementation of screening for OSA in cardiac rehabilitation settings and the optimization of compliance with treatment.

There are a number of potential obstacles in the practical implementation of the screening plan outlined in Figure 1. Some of these challenges have already been identified in a feasibility study of screening for OSA in a cardiac rehabilitation setting. \(^4\)1 This study conducted in 2007 at the Mayo Clinic-Rochester found that many patients did not have high compliance to follow referral and treatment recommendations following screening. It should be noted, however, that CPAP devices have become lighter, quieter, smaller and more acceptable to patients in recent years \(^7\)3 and this may result in improved compliance. The importance of assessing patient preferences for treatment is now better understood and may result in improved compliance to whichever treatment modality is preferred. \(^7\)1 The Mayo Clinic authors suggest that the lack of awareness and recognition of OSA as a possible contributor to increased risk for future adverse cardiac events may have resulted in the non-compliance of cardiac patients. \(^4\)1 It may be necessary to train and educate cardiac rehabilitation staff on the importance of sleep disorders so that they can effectively communicate this message to their patients. There is also limited evidence showing that short-term educational interventions or behavioural therapy may result in improved CPAP usage. \(^7\)4 There may also be potential practical concerns regarding the availability of portable home monitoring machines in cardiac rehabilitation programmes. It should be noted that the costs of these machines have lowered considerably in recent years as the technology has improved. \(^7\)5 Although there have been promising cost-effectiveness outcomes associated with screening and CPAP treatment in other disease conditions such as stroke \(^7\)6 and type 2 diabetes, \(^7\)7 the cost effectiveness in cardiac rehabilitation patients is yet to be demonstrated. Another potential challenge lies in the ongoing treatment of patients post-cardiac rehabilitation when most patients will return to a primary care setting with their local family physicians.

**Conclusion**

Focusing on detection of sleep disturbances early in the cardiac rehabilitation process and treating the OSA may help speed the recovery process and reduce recurrence of cardiovascular events. Patients who continue to be undiagnosed may experience a significantly worse outcome during their cardiac rehabilitation and recovery. It is highly recommended that all patients upon entry to cardiac rehabilitation programmes are screened for OSA using the STOP-Bang instrument. It is also recommended that cardiac rehabilitation staff are trained to administer and interpret this instrument and are aware of the importance of sleep disorders in this population.

**Author contribution**

MLG and AJ contributed to the conception or design of the work, contributed to acquisition, analysis and interpretation and drafted the manuscript. BM, DM, DL and HM contributed to analysis and interpretation. All critically revised the manuscript and agree to be accountable for all aspects of work ensuring integrity and accuracy.

**Declaration of conflicting interests**

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