Exercise physiologist’s role in clinical practice
B Franklin, A Fern, A Fowler, T Spring, A deJong

ABSTRACT
The use of exercise testing has expanded greatly to help guide decisions about medical management and prognosis in a broad spectrum of patients. Numerous epidemiological studies in people with and without documented coronary artery disease have identified a low level of cardiorespiratory fitness as an independent risk factor for all-cause and cardiovascular mortality and that exercise capacity is inversely associated with healthcare costs. Accordingly, unfit men and women should be counselled to exercise in home-based or group preventative or rehabilitative programmes. In the era of managed care, the use of specialised exercise professionals for the supervision of exercise testing and training may represent a safe and cost-effective alternative to many hospitals, clinics and private physician practices. Clinical exercise physiologists (CEPs) can play a critical role in favourably modifying clients’ level of cardiorespiratory fitness and physical activity habits. We detail the training of CEPs and outline the clinical settings where they have contributed substantially to healthcare delivery. We also outline the role of registered clinical exercise physiologists. It is important that exercise prescription is not left to a few individuals or small groups. It needs a concerted programme with all those in a position to make a difference actively contributing.

The expansion of modern medicine has contributed immensely to the early detection and treatment of chronic diseases, especially coronary heart disease (CHD). From 1980–2000, the age-adjusted death rate for CHD fell from 543 to 267 deaths per 100 000 population among men (51%) and from 263 to 134 deaths per 100 000 population among women (49%), resulting in nearly 342 000 fewer deaths from CHD in 2000.1 Technological, medical, preventive and rehabilitative advances are largely responsible for these decreases.

One of the most impressive gains in the management of patients with chronic disease has been the recognition of the benefits of structured exercise and increased lifestyle physical activity2 3 and their progressive incorporation into the mainstream of contemporary medical treatment plans. Patients afflicted with cardiovascular and pulmonary disease commonly experience a constellation of challenges, including a reduced exercise tolerance, associated symptomatology, depression,4 anxiety, escalating healthcare and prescription costs, and economic uncertainty. A superimposed sedentary lifestyle can exacerbate many of the associated disease-specific sequelae causing secondary complications such as reduced cardiorespiratory fitness, muscle atrophy, osteoporosis, overweight/obesity and impaired circulation to the lower extremities. Although there is much room for improvement, some physicians have embraced the use of exercise in the prevention, diagnosis and treatment of these clinical conditions and chronic health problems.5

The emergence of the clinical exercise specialist—a professional who uses exercise testing and/or training in the evaluation and management of a broad spectrum of healthy individuals and patients—has created the need for educating and training healthcare providers. Moreover, cost containment initiatives and time constraints on physicians have encouraged more extensive use of specially trained healthcare professionals (for example, nurses, physician assistants, physical therapists, exercise physiologists) to directly provide many of the diagnostic and treatment services under the overall direction of physicians. Although several professional organisations have responded by providing clinically oriented exercise physiology continuing education workshops or certifications (for example, American Council on Exercise (ACE), American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), American Heart Association (AHA), American College of Cardiology (ACC), Preventive Cardiovascular Nurses Association (PCNA)), perhaps the greatest recent emphasis on this area has been within the American College of Sports Medicine (ACSM), especially in regard to the training and certification of clinical exercise physiologists (CEPs).

EDUCATIONAL REQUIREMENTS AND CERTIFICATIONS
A practicing CEP will have earned a bachelor’s degree at minimum; however, students aiming to be CEPs are increasingly pursuing advanced degrees in exercise science, physiology or a closely related field. In most educational curricula, a clinical internship experience is required. Locations of student internships are dependent on the chosen area of expertise (for example, cardiology, sports medicine, wellness). Clinically, there is ample opportunity for CEPs in cardiology practices, conducting stress tests, and working in preventive cardiology and cardiac rehabilitation programmes.

Clinical certifications are often required by many hospitals, medical centres and private physician practices. Perhaps the most widely recognised and longstanding clinically oriented exercise certification is the ACSM’s Certified Clinical Exercise Specialist (CES). This level of certification requires a baccalaureate degree in exercise or health-related studies, 600 hours of relevant clinical experience, current cardiopulmonary resuscitation certification (basic life support) and the successful completion of a comprehensive examination now administered through computer-based testing. In addition, students who have attained their masters degree may be certified as registered clinical exercise physiologists (RCEP), which has a broader range...
of expertise as compared with the CES certification that focuses primarily on cardiovascular testing and rehabilitation.\(^4\) Goals of the RCEP are to improve visibility and acceptance of CEPs among the public, physician community and other health professionals, especially across varied disease states and comorbid clinical conditions, and to support the need for future licensure (that is, using nursing or physical therapy as models). Although other certifying agencies are available worldwide, the ACSM is one of the few that offers clinically oriented curricula, workshops and certifications. Increasingly, many CEPs decide to pursue doctoral or advanced degrees in exercise science, public health, physician assistant, nursing, business or combinations thereof (table 1).

The CES and RCEP titles are designated for exercise professionals who may work with high-risk or diseased individuals, as well as with apparently healthy people. The ACSM has published a list of the current knowledge, skills and abilities that comprise the foundations of these certification examinations, as well as the minimum requirements for experience, level of education and recommended competencies.\(^7\) The content matter for these clinical certifications is shown in box 1; a potential staffing plan for health/fitness and clinical services is depicted in fig 1.

Table 1 Levels of educational experience and associated clinical roles and ancillary responsibilities for the clinical exercise physiologists (CEPs)

<table>
<thead>
<tr>
<th>Education</th>
<th>Certification</th>
<th>Clinical roles</th>
<th>Ancillary responsibilities</th>
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<tr>
<td>Bachelor of Health/Exercise Science or related degree</td>
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<tr>
<td></td>
<td>American College of Sports Medicine (ACSM) Certified Clinical Exercise Specialist</td>
<td>Cardiac Rehabilitation</td>
<td>Clinical coordinator or supervisor</td>
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<td></td>
<td>Certified Strength and Conditioning Specialist*</td>
<td>Diagnostic Stress Testing</td>
<td>Personal fitness trainer</td>
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<tr>
<td></td>
<td>ACSM Certified Health Fitness Specialist</td>
<td>Clinical Weight Management</td>
<td>Wellness specialist</td>
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<td></td>
<td></td>
<td>Chronic Disease Exercise Prescription</td>
<td>Corporate fitness specialist</td>
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<td></td>
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<td></td>
<td>Research coordinator/leader</td>
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<td></td>
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<td></td>
<td>Manuscript authorship</td>
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<tr>
<td>Masters in Exercise Physiology</td>
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<td></td>
<td>ACSM Registered Clinical Exercise Physiologist</td>
<td>Cardiac Rehabilitation</td>
<td>College/university faculty</td>
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<td></td>
<td></td>
<td>Diagnostic Stress Testing</td>
<td>Programme director</td>
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<td></td>
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<td>Pulmonary Rehabilitation</td>
<td>Research coordinator/leader</td>
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<tr>
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<td></td>
<td>Metabolic Disease Management</td>
<td>Manuscript authorship</td>
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<td></td>
<td></td>
<td>Cancer Recovery</td>
<td>Support grant writing</td>
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<tr>
<td>Doctorate in Exercise Physiology</td>
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<td></td>
<td>ACSM Registered Clinical Exercise Physiologist</td>
<td>Clinical Programme Director</td>
<td>College/university professor</td>
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<td>Clinical Research and Development Coordinator</td>
<td>Manuscript authorship and oversight</td>
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<td></td>
<td></td>
<td>Medical Board of Directors</td>
<td>Grant writing</td>
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</table>

*National Strength and Conditioning Association.

PROFESSIONAL SCOPE AND RESPONSIBILITIES

CEPs are required to have exceptional understanding and working knowledge of acute and chronic responses and adaptations to exercise in healthy and unhealthy individuals, as well as the influence of varied comorbid conditions and medications. These professionals are often responsible for designing exercise programmes and formulating exercise prescriptions for those with chronic disease such as CHD and other cardiovascular conditions, diabetes mellitus, metabolic syndrome, obstructive pulmonary disease, cancers, arthritic disorders and obesity. CEPs often work with patients immediately following cardiac interventions and/or events and are an integral part of the cardiovascular continuum of care. Accordingly, such individuals should be highly trained in conducting diagnostic stress tests and adept at interpreting 12-lead electrocardiograms (ECGs) and ECG rhythm strips. Exercise training, risk factor modification, haemodynamic and ECG telemetry monitoring, and patient education and counseling are additional competencies in the physiologists’ clinical armamentarium. Lifestyle modification and exercise training also serve as integral components of comprehensive clinical interventions for overweight/obese patients.\(^6\)

As exercise interventions have become increasingly adopted for the treatment and prevention of chronic diseases and disorders, CEPs are often employed as support staff for clinical research trials involving these patient subsets. CEPs play an important role in data collection, programme design, treatment interventions, grant writing and subsequent publication and presentation of the findings. Many international organisations (for example, AHA, ACC, ACSM, AACVPR) now consider CEPs as valued multidisciplinary participants in annual scientific meetings, symposiums and focus groups. Community organisations often invite CEPs as authoritative speakers on subjects related to exercise, weight management and lifestyle modification. Masters and doctorate prepared CEPs also serve on the faculty at community colleges and universities, instructing undergraduate and graduate students in exercise physiology and related disciplines.

CEPS SUPERVISE SAFE EXERCISE TESTS IN HIGH-RISK POPULATIONS

A major role for the CEP is in the conduct and administration of exercise testing, with and without concomitant cardiopulmonary measures and/or myocardial perfusion imaging. CEPs are now widely recognised by the medical community as being uniquely qualified to supervise exercise testing, including those patients at increased risk for cardiovascular complications, if a physician is within close proximity and readily available to respond to an emergent situation.\(^7\) This is in contrast to exercise testing prior to 1980, which was directly supervised (>90% of the time) by physicians.\(^10\) Since then, clinical practice patterns have shifted due to cost-savings initiatives and escalating time constraints on physicians, resulting in the use of specially trained allied health professionals, including CEPs, to supervise exercise tests.

The safety of non-physician supervision of exercise testing is now well-established. Knight and associates demonstrated an exemplary safety record when using CEPs, including no fatalities, only four myocardial infarctions and five episodes of ventricular fibrillation in over 28 000 tests.\(^11\) Franklin et al\(^12\) reviewed 18 years (1978–1995) of exercise testing experience by non-physicians (highly trained CEPs and nurses, credentialed in basic cardiopulmonary resuscitation and advanced cardiac life support) who performed over 58 000 tests, which included a...
significant subset of higher-risk patients (~15–20%). There were 14 complications (including 2 fatalities) for an event rate of 1 per 4146 exercise tests. Collectively, these data suggest that the overall incidence of cardiovascular complications appear to be no higher with experienced paramedical personnel than during exercise testing with direct physician supervision.\textsuperscript{12, 13}

The role of the CEP during stress testing may include pre-test preparation and evaluation, test supervision, haemodynamic monitoring and documentation, ECG surveillance, and providing a preliminary test summary to guide the final physician interpretation. Several reports now suggest that highly trained allied health professionals can provide an accurate preliminary assessment of the exercise ECG, in excellent agreement with internal medicine and/or cardiologist consultant over-reads.\textsuperscript{14–16} The CEP can also identify contraindications to exercise testing and appropriately summon the overseeing physician if additional pre-test evaluations are warranted. In addition, CEPs can use test endpoints, as established by the ACSM,\textsuperscript{7} to terminate an exercise test at an appropriate intensity level. If an exercise test is prematurely terminated due to adverse signs or symptoms, including a significant ischaemic ECG response, increasing angina pectoris or malignant ventricular arrhythmias, it is the CEP’s responsibility to convey this information in a timely manner to the attending or referring physician. In situations where an emergency arises, CEPs serve as part of the initial emergency response team until the covering physician arrives.

**CEP’S ROLE IN DESIGN AND SUPERVISION OF MEDICAL EXERCISE PROGRAMMES**

CEPs also function in the design and supervision of structured exercise programmes for apparently healthy individuals and those with chronic disease. Their role includes restoring or enhancing the patient’s functional capacity, helping clients to reduce body weight and fat stores, improving their cardiovascular risk profile and educating them on the long-term benefits of a regular exercise programme, increased lifestyle activity\textsuperscript{7} or both. Exercise prescriptions are formulated based on knowledge obtained from formal educational training, clinical internship and on-the-job education, and through workshops and certification examinations. This training allows the CEP to safely and effectively address the individual needs of each programme participant.

Although the CEP can be employed in many settings, including fitness centres, cardiac and/or pulmonary rehabilitation programmes, physical therapy clinics and specialised fitness facilities, their predominant role is in medically oriented diagnostic and treatment centres. Traditionally, this role has been in the rehabilitation of the cardiac patient; however, recent practice patterns have expanded their role to include working with patients with other chronic diseases and debilitating medical conditions, including pulmonary, metabolic, immunological, inflammatory, orthopaedic and neuromuscular disorders. Moreover, the ACSM RCEP has enhanced education and training to enable them to work with people with chronic diseases and medical conditions such as muscular dystrophy, Parkinson’s disease and osteoporosis, for whom exercise may be beneficial.\textsuperscript{7} CEPs work to reinforce health behaviours and track progress of the exercise programme within a team of licensed healthcare professionals, which may include nurses, psychologists and physicians.

The scope of responsibilities for the CEP in the rehabilitative setting includes diagnostic and functional testing, exercise prescription, exercise supervision, patient counselling, education and outcomes analysis. In addition, the CEP may address barriers to maintaining exercise compliance, including psychosocial factors, family or job responsibilities, orthopaedic or musculoskeletal limitations, or other deterrents to regular exercise. Box 2 highlights the role a CEP might play in a comprehensive rehabilitative exercise programme.

**INTERNSHIP MENTORING AND ANCILLARY ALLIED HEALTH PROGRAMMES**

**Internship mentoring**

The role of the qualified CEP as an internship mentor is a noble one, serving as a “teacher” in the profession. A hands-on clinical experience under the guidance of a seasoned exercise physiologist can have a profound and favourable impact on the students’ career direction. It is critically important that students are exposed to inpatient and outpatient cardiac rehabilitation, exercise leadership (aerobic, resistance and functional training), stress testing (dynamic and pharmacological), counselling/educating patients and research methodology so that they have appropriate experience for employment.\textsuperscript{18}
### Box 2 Role of the exercise physiologist in the functional assessment and exercise training of patients with cardiovascular disease (adapted from 17)

- Assess exercise tolerance:
  - evaluate adverse signs/symptoms
  - consider medical history and health status
  - assess barriers to exercise.
- Establish treatment goals:
  - collaborate with referring physician and other licensed professionals
  - assist in identifying patient short-term and long-term objectives.
- Individualise exercise-based interventions:
  - determine "readiness to change"
  - promote safety and effectiveness
  - counsel patient on lapses or setbacks.
- Monitor progress:
  - conduct outcome evaluations
  - provide updates to the patient and referring physician
  - encourage pleasurable activities in a supportive environment.

The qualified CEP can positively influence the student’s interpersonal skills as well as his or her rapport with patients and support staff. This is reflected in teaching the clinical components of cardiac rehabilitation (phases I, II and III), which include ECG telemetry monitoring for ischaemia and arrhythmia recognition, formulating individual exercise prescriptions, cardiac risk factor identification, patient education and counselling, and responding appropriately to exercise-related untoward events. The positive influence of didactic instruction during this educational phase transforms “textbook learning” to the development and implementation of knowledge, skills and abilities.

A group exercise setting can be an intimidating environment for the student intern. The CEP must ensure that patients have full confidence while they remain under the intern’s direction; this is paramount for the client/instructor relationship. Music and props can provide a relaxed and enjoyable environment for both patients and novice exercise professionals. Using a variety of arm, leg or combined arm-leg ergometers and exercise equipment (for example, free weights, resistance bands or tubing, body bars, baskets, volleyballs, walking sticks) can also be helpful.

Although stress testing represents a dynamic and insightful clinical methodology, the potential to elicit threatening somatic, haemodynamic and ECG responses. In rare instances, such testing may provoke acute cardiac events. This may be especially disconcerting to the student observer. Accordingly, the CEP should guide the student intern gradually (that is, increasing performance expectations and competencies over time) while identifying and addressing his or her strengths and weaknesses during the designated rotation. Dynamic and pharmacological stress testing instruction to student interns includes explaining the purpose and rationale for the evaluation, underlying methodology (for example, perceived exertion scale), potential adverse signs/symptoms, elements of 12-lead ECG and rhythm strip interpretation, obtaining accurate blood pressure readings, knowledge of indications and contraindications, and the confounding effects of medications and/or underlying disease on the associated responses.

The CEP may also augment the undergraduate student’s limited knowledge in research methodology with assignments. For example, one project could focus on how to conduct a literature review and plan a “mock” research trial with execution of the statistical analysis. Alternatively, previously published studies may be reviewed and critiqued with specific reference to methodological limitations (for example, lack of a “control group”).

Providing tutorials and lectures on topics of clinical significance (for example, 12-lead ECG interpretation, special populations, stress testing, cardiac medications) will help to integrate “book knowledge” with “hands-on experience”. In addition, this presents an opportunity for the supervising CEP to mentor students in their particular areas of proficiency or clinical expertise.

Written and practical examinations for interns developed and/or administered by the CEP are key to identifying competencies in which students excel or exhibit shortcomings. These types of tests are an excellent preparation for the CES or RCEP certification exams. The exercise physiologist can also introduce students to professional organisations such as the ACSM or the AACPR, their regional affiliates, local and national meetings, committees and educational and research missions.

### Geriatric exercise programmes

Although exercise physiologists are widely employed in cardiac rehabilitation programmes, other staffing opportunities have become increasingly available for them in chronic disease management and allied health programmes. For example, hospital-based community wellness exercise programmes can provide a medical setting for older adults who wish to exercise in a supervised and reassuring environment.

Providing physical conditioning classes that are directed toward the senior population (that is, group low impact or aquatic aerobics, resistance training, flexibility/agility activities, tai chi) with pulse monitoring, blood pressure checks and instantaneous ECG rhythm strip surveillance can create a unique exercise experience that is not offered at commercial facilities. For example, a CEP can track and provide pertinent haemodynamic and ECG information to a patient’s physician, aiding in the treatment of chronic medical conditions and extending the continuum of care.

A primary objective of the CEP for wellness programmes is in improving or maintaining the cardiorespiratory and musculoskeletal fitness levels of apparently healthy older adults in a closely supervised setting. The CEP should identify cardiac risk factors (for example, hypertension, diabetes, hypercholesterolemia, cigarette smoking, obesity) and musculoskeletal conditions (for example, previous injuries or surgeries), set short and long-term goals (for example, weight loss, and improving cardiorespiratory fitness) and then formulate an individual exercise plan. The programme’s credibility is enhanced by the presence of a certified or registered exercise professional that can oversee and monitor patient progress.

### EXTENDED CEP SERVICE—ENHANCED EXTERNAL COUNTERPULSATION

An alternative treatment for patients with cardiovascular disease in which a CEP can extend services includes enhanced external counterpulsation (EECP). EECP is a non-invasive therapy that can reduce angina symptoms and improve exercise tolerance in symptomatic patients with CHD who are no longer responsive to drug treatment or repeated revascularisations.
Aspects of the methodology and treatment plan are summarised in box 3. Common contraindications to EECP therapy include active thrombophlebitis (history of deep vein thrombosis requires current ultrasound clearance), unstable angina, severe lower extremity vascular disease, documented aortic aneurysm requiring surgical repair and pregnancy. Although the exact physiological mechanisms by which EECP provides clinical benefits to patients remains unclear, there is evidence that the benefits are multifactorial and involve augmented blood flow to ischaemic myocardium, enhanced vasomotor function, improvements in left ventricular diastolic performance, increased somatic oxygen consumption at rest or combinations thereof.22–23

The responsibilities of the CEP include prepping and monitoring the patient during EECP therapy sessions, pre and post-therapy evaluations of lung sounds to assess for fluid retention, oxygen saturation levels, blood pressure and ECG rhythms, as well as weighing the patient at each session to monitor for congestive heart failure. Exercise professionals can also provide the referring physician with periodic updates about the patients’ clinical and physiological responses to the treatment plan, especially if adverse signs and/or symptoms are noted.

COUNSELLING AND COMMUNITY EDUCATION

Increasingly, the demands placed on physicians’ time may limit their ability to effectively counsel patients on the benefits of exercise, exercise prescription and comprehensive lifestyle risk factor modification. Physical inactivity is the only major risk factor common to obesity, diabetes, cardiovascular disease and metabolic syndrome. Studies show that physicians consistently discuss exercise with less than a third of their patients and that exercise counselling is more often employed as a secondary prevention measure.24–27 The aging US population and predicted future physician shortages will only serve to augment these challenges. Accordingly, CEPs are in a unique position to complement the physician and his or her support staff through the exercise and risk factor reduction counselling of their patients in a variety of settings.

CEPs play an integral role in clinical practice by assisting with global risk factor reduction for patients with CHD, diabetes, metabolic syndrome and obesity. Counselling participants with chronic diseases and disabilities on the lifestyle behaviours that contributed to these conditions (that is, physical inactivity and unhealthy eating patterns) through group lectures, one-on-one consultations and regular interactions can facilitate substantive behaviour changes. In addition, providing serial surveillance about their risk factor reduction to referring physicians, physician assistants and nurse clinicians may serve to improve participant outcomes.

Within the settings of employee and community health programmes, such as heart and vascular screenings, CEPs are also poised to deliver health, wellness and fitness coaching. Included in the risks for most chronic diseases and medical conditions is an overriding behavioural component that contributes to either positive or negative outcomes. Behaviour patterns have the single greatest impact on premature death and disability, surpassing genetic predisposition, social circumstances, healthcare availability and environmental exposure.28–30 Health and wellness coaching improves self-efficacy—that is, the individual’s ability to formulate and implement a successful plan while addressing compliance barriers. CEPs are also trained to identify a participant’s readiness to make lifestyle changes and determine the likelihood that they will maintain compliance to a prescribed programme. The strategies (that is, goal setting, motivational interviewing, reward systems) used by the CEP to favourably alter lifestyle behaviours are dependent on both of these modulating variables.

Community involvement is another essential function of CEPs that aids in the dissemination of valuable exercise and health information. Knowledge is the first step in preparing an individual to make long-term behaviour changes. Well-written articles in lay publications (for example, newspapers, magazines, patient newsletters) can be helpful. Presentations to gender-specific groups, weight control centres, organisation-sponsored events (for example, American Heart Association “Start! Heart Walk”) and association conferences are ideal opportunities to communicate with other allied health professionals and the public at large. Media interviews, often focusing on recent studies, also help to clarify the implications for patients and providers on various health issues.

SUMMARY AND PRACTICAL IMPLICATIONS

Traditionally, CEPs have been viewed as personal trainers or cardiopulmonary specialists. As the medical community begins to act on the evidence that exercise is medicine29 for both prevention and treatment, CEPs will become increasingly embraced and employed as health professionals. Collectively, their clinical knowledge, skills and abilities allow exercise physiologists to assist physicians in the diagnostic and functional evaluation, education and behaviour modification of their patients. As rehabilitation specialists, researchers, employee health programme coordinators, health and wellness coaches, and community and professional educators, CEPs are invaluable resources in interventions designed to combat virtually all chronic diseases, not just CHD, diabetes and obesity.

Competing interests: None.

REFERENCES