

Cardiometabolic medicine: a review of the current proposed approaches to revamped training in the United States

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Cardiovascular disease (CVD) remains the leading cause of mortality in the United States, and the population of patients with cardiometabolic conditions, including obesity, metabolic syndrome and diabetes mellitus, continues to grow. There is a need for physicians with specific training in cardiometabolic medicine to provide a 'medical home' for patients with cardiometabolic disease, rather than the fractured care that currently exists in the United States. Cardiometabolic specialists will head multidisciplinary clinics, develop practice guidelines, and lead through research. Proposals for US training in cardiometabolic medicine include: maintain the current training model, a dedicated 2–3 year fellowship following internal medicine residency, a 1-year fellowship following either internal medicine residency or fellowship in cardiology or endocrinology, and certification available to any interested clinician. This review discusses the

pros and cons of these approaches. The authors believe that a dedicated cardiometabolic training fellowship has significant advantages over the other options. *Cardiovasc Endocrinol Metab* 10: 168–174 Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.

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Introduction

Globally and particularly in the United States, rates of obesity, metabolic syndrome and diabetes mellitus have been steadily increasing [1,2]. These conditions are each strongly associated with an increased risk of cardiovascular disease (CVD). Collectively, they represent a growing population of cardiometabolic patients that require interdisciplinary preventive clinical management, benefiting the most when care is coordinated between primary care, cardiology, endocrinology and nutrition and lifestyle specialists.

Diabetes mellitus is representative of this growing health burden, with the estimated 34 million US adults with diabetes in 2018 projected to increase almost three-fold by 2060 [3]. CVD remains the leading cause of morbidity and mortality among patients with type 2 diabetes mellitus, with death from heart disease being two to four times greater among patients with diabetes than those without [2,4]. As an ever-greater number of patients are living with cardiometabolic conditions, the focus is being placed on chronic preventive management. It is not uncommon for a patient to be managed by a multitude of specialists, including a primary care provider, cardiologist,

endocrinologist, vascular medicine specialist, nephrologist and nutritionist/dietitian. This comanagement often results in confusion for the patient and their providers and can lead to potentially adverse circumstances such as polypharmacy.

One aspect of the healthcare structure that can be leveraged to address the needs of cardiometabolic patients is physician training. Historically in the United States, patients with diabetes mellitus and CVD are managed by either generalists trained in internal medicine or by subspecialists in the currently disparate fields of endocrinology and cardiology. With the burden of treating a wide breadth of patient concerns, generalists often seek referral to subspecialists for optimized preventive care. Endocrinologists primarily manage diabetes mellitus and other metabolic diseases, while high-risk patients with diabetes mellitus and CVD are more likely to be managed by cardiologists [5]. These specialists must then rely on their organ-system-specific training from fellowship and continuing medical education (CME), which may not adequately prepare physicians to address every aspect of the cardiometabolic patient [6,7]. Furthermore, skills, such as counseling on lifestyle behavior modification and management of novel cardiometabolic medications, such as sodium-glucose co-transporter-2 (SGLT2) inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists, remain focal points where physician uptake can be improved through training [8–12]. Currently, it is

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not clear which specialist will oversee the management of these medications, and as a result, they might never be initiated [13]. Highlighting this issue, a recent study found that among a large cohort of US patients with diabetes mellitus and CVD, 87.8% were prescribed a statin, but only 9.0 and 7.9%, respectively, were prescribed an SGLT2 inhibitor and GLP-1 receptor agonist [6].

While there is a need for focused cardiometabolic medicine training for physicians, no such standardized program exists. Many approaches have been proposed to bridge this training gap and are summarized in the following sections of this review (Fig. 1).

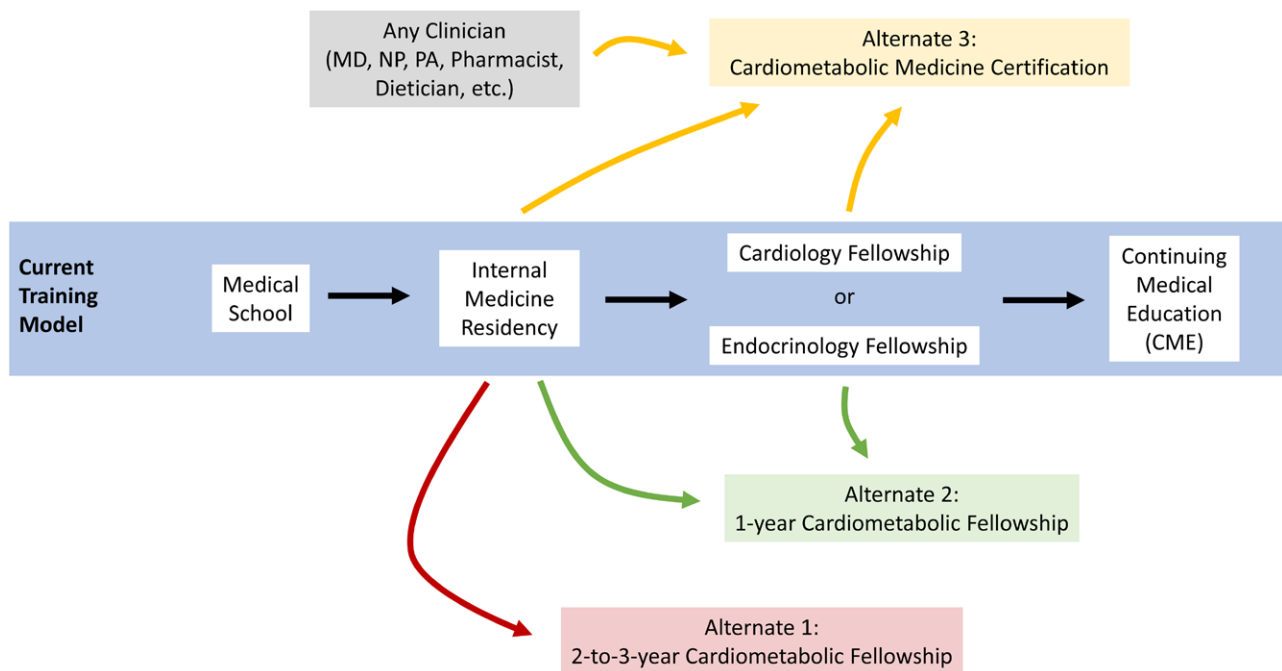
Current training model

The current framework of cardiometabolic training in the United States is through one of two distinct specialty pathways: cardiology or endocrinology. These follow residency in internal medicine (3 years), with additional subspecialty training in either general cardiology (3+ years) or endocrinology, diabetes and metabolism (2–3 years). Residents in internal medicine participate in inpatient and outpatient clinical rotations each year of training and develop basic clinical management skills necessary to independently conduct primary care for the cardiometabolic patient. Preventive care of chronic conditions such as hypertension and hyperlipidemia are mainly taught in the acute care setting. Lifestyle practices such as smoking cessation, nutritional counseling,

and weight management are covered only briefly during residency [14,15]. These skills are primarily built upon following completion of house staff training; however, they are underutilized to the same degree by both resident and attending physicians. Residents practice in clinical teams throughout training, developing essential skills for working in a multidisciplinary setting. The third year of internal medicine residency allows for components of customizable training, affording opportunities to seek out rotations in cardiology and endocrinology to gain further exposure to management of cardiometabolic patients [16].

Advanced concepts in cardiac disease prevention education have traditionally been part of cardiology training programs. Primary and secondary prevention of atherosclerotic CVD is a core learning principle of general cardiology fellowship [17]. All fellows are required to complete at least a 1-month rotation dedicated to CVD prevention, which should include experiences in clinics focused on cardiac rehabilitation, diabetes or endocrinology, hypertension, and dyslipidemia management. Education during this month is focused on learning risk factor modification strategies. This rotation can be substituted with a 3-month or longer training period for those particularly interested in cardiometabolic disease. Approximately ten clinical subspecialty fellowships in CVD prevention exist, ranging 1–2 years of additional training after completion of general cardiology

Fig. 1



Proposed approaches to cardiometabolic training.

fellowship, though these are not currently accredited by the Accreditation Council for Graduate Medical Education (ACGME) [18,19].

Cardiovascular disease prevention training is not a primary focus during an endocrinology fellowship. The ACGME does, however, require programs to provide education in the core competencies of disease prevention and the ‘prevention and surveillance of microvascular and macrovascular complications,’ which includes CVD [20]. Extensive training in management of type 1 and type 2 diabetes mellitus, lipid disorders, and obesity is provided, including the development of nutritional and lifestyle counseling, preparing physicians to address these aspects of cardiometabolic patient care [21]. Following completion of endocrine fellowship, no subspecialty fellowship training is available to provide additional specialized education in cardiometabolic medicine.

To further illustrate the gaps in this current training model, consider the case of the lead author on this manuscript, who is a medical student pursuing residency in internal medicine with interest in caring for cardiometabolic patients. Midway through his residency training, he will have to choose to either (1) become a primary care provider immediately following completion of residency, pursue his own educational materials on cardiometabolic care, and practice with minimal, focused training in cardiometabolic medicine or (2) pursue fellowship training in either cardiology or endocrinology. As is the case with most trainees in this situation, he will likely pursue subspecialty training. If he elects to complete a cardiology fellowship, a majority of his training will be focused on acute and critical care cardiovascular management, with significant time spent on developing procedural skills and postprocedural follow-up. If he elects to complete a fellowship in endocrinology and metabolism, he will be required to complete extensive clinical training in thyroid, bone and neuroendocrine disorders. Even after subspecialty training, he may very likely have to pursue additional CME training in topics such as fatty liver and obesity management to further develop his limited expertise. Either path necessitates training in skills that would be minimally applicable in a cardiometabolic clinic and neither path allows for in-depth training across clinical departments.

While this review focuses on the United States, similar gaps exist in training models throughout the world. Though parallels in need for and growing interest in focused cardiometabolic training are common across countries, credentialing and healthcare delivery structures vary. Country-specific surveys of perceptions are needed to elucidate the best avenues for improved training.

Alternate 1: cardiometabolic fellowship of 2–3 years following internal medicine residency

One proposal is for a dedicated multiyear fellowship track in cardiometabolic medicine. After completion of

residency training in general internal medicine, residents would complete an additional 2–3 years of subspecialty house staff training and focus on advanced topics in cardiology and endocrinology [22–24].

The cardiology component would be centered around primary and secondary prevention of atherosclerotic disease. Clinical training would include electrocardiograph interpretation, cardiac imaging (interpretation of echocardiography, stress testing, and noncontrast and contrasted coronary computed tomography), hypertension management, cardiac rehabilitation, vascular medicine, inpatient cardiology consultations and outpatient preventive cardiology clinic. Of note, certain elements classically covered in a cardiology fellowship that would be excluded are interventional cardiology, electrophysiology, critical care medicine, advanced heart failure and cardiac transplantation.

The endocrine component would be focused on extensive training in management of type 1 and 2 diabetes mellitus, metabolic syndromes, obesity, hypertension and lipid and lipoprotein disorders. House staff training would involve frequent interactions with endocrine and bariatric surgeons. Advanced topics in glucose management would include basal-bolus insulin administration, insulin infusion pumps and continuous glucose monitoring. Education in obesity medicine would include obesity pharmacology, nutrition therapy and management of bariatric surgery patients. Advanced lipid topics would include education in statin intolerance, moderate to severe hypertriglyceridemia and genetic lipid and lipoprotein disorders. Of note, endocrine training classically covered in an endocrinology fellowship that would be excluded are disorders of the thyroid, parathyroid, hypothalamic-pituitary-adrenal axis, reproductive endocrinology and metabolic bone disease.

Advanced concepts in lifestyle modification will also represent a significant portion of cardiometabolic medicine training, with particular focus on diet, exercise and substance use [25]. Topics would include nutrition counseling and coordinating with nutritionist staff, exercise counseling and use of mobile health technology, as well as substance (tobacco, novel tobacco products including electronic cigarettes, alcohol, illicit drug) cessation counseling and pharmacology [26,27]. Complimentary education in behavioral sciences and human psychology would allow trainees to augment these skills.

Finally, a cardiometabolic medicine fellowship would allow trainees to become leaders in their recognized field. By gaining experience leading multidisciplinary clinical teams, trainees would be able to hone leadership skills under the guidance of a diverse group of attending physicians. Coursework in epidemiology and biostatistics would focus on competency in conducting and interpreting population studies, while protected time would be available for in-depth research experiences [28]. The

complexity and volume of data inherent to cardiometabolic epidemiology necessitates proficiency in these skills for both clinical practice and academic pursuits. Such training would empower cardiometabolic trainees to be future stewards of areas where data is difficult to gather and interpret, such as with pertinent lifestyle factors, including diet and exercise. Those who are interested in further research training would have the option of taking an additional 1–2 years to pursue a Master of Health Science or Master of Public Health degree under the mentorship of faculty conducting cardiometabolic research.

The benefit of this approach is that training centers around the opportunity to completely revamp subspecialty training in cardiometabolic medicine. Curricula, clinical experience and mentorship would be tailored specifically to the needs of a cardiometabolic specialist, allowing for a depth of exposure to a breadth of relevant topics that is currently not available in a single training program. The opportunity cost of this focus, however, is the loss of noncardiometabolic topics traditionally covered in cardiology and endocrinology fellowships. The adaptability of such general training has become more apparent in current times, as cardiologists have been drawing on their training in critical care medicine to serve as intensivists during the COVID-19 pandemic [29,30]. Additionally, there is a significant challenge faced by teaching institutions of creating a multiyear cardiometabolic fellowship training curriculum in collaboration with multiple medical departments and stakeholders. Pursuing accreditation by the ACGME is another challenge that programs will face.

Alternate 2: subspecialty training of 1 year following either internal medicine, cardiology, endocrinology or nephrology

Another proposal put forth is that of a 1-year interdisciplinary cardiometabolic subspecialty fellowship track [31]. Some have proposed that such training would be best suited for those who have already completed a general cardiology fellowship [17,32]. However, this could follow subspecialty training in either cardiology, vascular medicine, endocrinology or nephrology, in addition to being available for those who have completed a general internal medicine residency. While suggested proposals have generally focused within these medical specialties, such fellowship training could also be made available to interested specialists in vascular surgery, cardiac surgery and radiology.

The year would be split into two halves, with the first 6 months dedicated to equal time spent in advanced outpatient training in endocrinology, preventive cardiology and nephrology. Following the completion of these core cardiometabolic rotations, fellows would have the opportunity to personalize their remaining 6 months of training with ambulatory training in vascular medicine,

weight management, sleep medicine, women's cardiovascular health or by conducting rigorous cardiometabolic research. Cardiac rehabilitation, nutritional management and lifestyle counseling education would be integrated as longitudinal competencies throughout the year.

Similar to other proposals, core foundational rotations would focus on topics most relevant to cardiometabolic specialists. Endocrinology training would include management of type 1 and type 2 diabetes mellitus, as well as antihyperglycemic therapy, including insulin initiation/titration and other medications such as GLP-1 receptor agonists and SGLT2 antagonists. Preventive cardiology training would focus on lipid-lowering therapies and the use of advanced lipoprotein profiling, coronary artery calcium scoring and cardiac computed tomography in risk stratification. Nephrology training would focus on the management of hypertension and chronic kidney disease.

While this tract is focused on training for the cardiometabolic clinician, it could be adapted for those seeking more focused physician-scientist training in cardiometabolic disease prevention [18]. This could be accomplished the one-year fellowship by substituting clinical experiences in the latter portion of the year with dedicated training in research methodology and grant writing skills. An additional year would be available to those who wish to pursue more intensive time spent on research activities, allowing the trainee to engage in basic science, translational, outcomes or health services research in preparation for an academic career [33].

This training model has many of the same advantages and disadvantages as Alternate 1. Notably, it would allow for the training of dedicated cardiometabolic specialists who come from diverse clinical backgrounds. This, in tandem with the shorter course of training, would allow for the expedited deployment of practicing cardiometabolic specialists. However, the short timeline necessitates a more judicious use of time during the standard 1-year program period, requiring those who are interested in research and academic development to add more training time. Nonetheless, this flexibility in the program is also a significant strength. The challenges of curricula development and ACGME accreditation remain. A further limitation is the prolonged training period, with the aspiring cardiometabolic physician having to spend added years in training prior to starting a career [34].

Alternate 3: certificate available to any interested clinician

One proposal is for a cardiometabolic medicine certification available to any interested clinician. The framework for such topic-focused CME activities pertinent to cardiometabolic medicine already exists, ranging from multi-day live courses to self-directed online modules [18,26]. Various professional organizations, such as the American Heart Association, government research entities such as

Table 1 Advantages and disadvantages of proposed training changes

Training model	Strengths	Weaknesses
Alternate 1: Cardiometabolic fellowship after internal medicine residency	Dedicated subspecialty track Multiyear focused training Breadth of clinical experiences Education on topics that currently do not fall under one specialty (i.e., obesity management) Less time spent on noncardiometabolic subspecialty training Dedicated time to develop research and leadership skills	Requires creation and accreditation of curricula for a brand-new multiyear fellowship Requires collaboration between cardiology and endocrinology
Alternate 2: subspecialty training after internal medicine, cardiology, endocrine or nephrology training	Dedicated subspecialty track Single-year focused training Available to a broad group of trainees Flexibility in curricula	Additional training time for physicians who have already undergone many years of graduate medical education Requires adding more time for research and academic training Requires creation and accreditation of curricula for a brand-new one-year fellowship Cannot effectively create cardiometabolic experts who will become the "home" for patient care Limited training potential given small scope Little to no structure for research or academic support Unlikely to result in systemic changes to the delivery of cardiometabolic care
Alternate 3: certificate available to all clinicians	Accessible to all clinicians Allows for training more providers overall than other models Highly individualizable curricula Potential for rapid uptake CME certification simpler than ACGME accreditation	

ACGME, Accreditation Council for Graduate Medical Education; CME, continuing medical education.

the National Heart Lung and Blood Institute, nonprofits such as the Gables Institute, and academic medical centers such as the Mayo Clinic offer such coursework. One example is a 'Masters in Lipidology Course' offered by the National Lipid Association: a 2-day course available to physicians, physician assistants, dietitians, pharmacists and nurses [35]. Such certification programs exist for nutritional counseling, cardiac rehabilitation, lifestyle counseling, advanced insulin management, cardiovascular epidemiology and many of the other topics central to preventive cardiology [36–38].

A certification in cardiometabolic medicine would represent streamlined educational materials from the fields of cardiology, endocrinology, lifestyle modification and biostatistics that are most essential in the clinical management of cardiometabolic patients. Necessary components included would be an overview of updated clinical guidelines from professional societies, indications for initiation and cessation of pharmacological management and behavioral counseling skills development. Training would be competency focused, preparing clinicians with a foundational knowledge base that would allow them to then pursue additional CME expertise in topics relevant to cardiometabolic medicine.

The major strength of this training approach is its wide accessibility for physicians and other clinicians from all training backgrounds. Developing modular and cumulative curricula would allow for rapid dissemination of cardiometabolic training, enabling each clinician to tailor their studies to the patient population they already serve. Additionally, receiving CME certification for a course is comparably simpler than receiving ACGME accreditation for a fellowship program. However, this alternative does not create a unified 'home' for cardiometabolic patients. An example of how this could negatively impact patient care is through hampered referrals: a cardiologist cannot refer to another cardiologist with this certificate and bill

as a new patient, limiting the ability to build a cardiometabolic care pathway or dedicated clinic. Additionally, it offers limited support for those who wish to become clinical or research leaders within the field. Without systemic prioritization of such opportunities for trainees through a subspecialty program, there remains untapped potential, making it unlikely that major benefits to cardiometabolic care can be expeditiously realized.

Conclusion and future directions

Many training models have been suggested to address the need for physicians educated in cardiometabolic medicine (Table 1). There exists a framework within cardiology and endocrinology fellowship programs that provides minimal training in CVD prevention, which could be augmented to incorporate more principles of cardiometabolic care. New specialty fellowships have also been proposed, ranging from 1 to 3 years in length, that would be available to physicians who completed internal medicine residency training or who wish to subspecialize after completion of cardiology or endocrinology fellowship training. Additionally, there have been proposals for a comprehensive certificate program in cardiometabolic medicine that would be available to any interested clinician.

Given the growing population of cardiometabolic patients, implementation of one or more such clinical training pathways would have the potential to greatly impact the status of cardiovascular health in the United States for current and future generations. Overall there is consensus among clinicians that it is time for a revised cardiometabolic training structure, though more favor smaller incremental changes at the current moment. A recent online poll confirmed interest in each of the proposed training approaches, with over 80% of responders favoring new training approaches over what is currently available [39]. With growing need for cardiometabolic-trained

physicians, increasing interest in training and expanding research in preventive cardiology, the field will be best served long-term by establishing a dedicated fellowship. The road to a stand-alone cardiometabolic fellowship may likely begin with the establishment of certification programs, with certification curricula serving as a precursor for the development of a fellowship-based training program. A dedicated cardiometabolic fellowship will ultimately train specialists to become the clinical 'home' for patient care and lead future discoveries through research.

Each of the proposed training approaches represents different stages along a continuum towards a final goal: training physicians to better care for the cardiometabolic patient population. With certification being the simplest option to implement, it will likely be the first to become available for those interested. Eventually, 1-year subspecialty fellowships will arise, leading to the development of a dedicated fellowship. Non-ACGME accredited fellowships will likely be established first, leading the way to an accredited fellowship track. With a dedicated fellowship, cardiometabolic medicine can be established as its own medical specialty and will garner interested trainees for generations to come. Such growth in cardiometabolic training will not only provide improved clinical care to patients, but also a destination for interested trainings, a route for innovating new care pathways, and will catalyze research in this field.

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Conflicts of interest

There are no conflicts of interest.

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