2010 Canadian Cardiovascular Society/ Canadian Heart Rhythm Society

for Training and Maintenance of Competency in Adult Clinical Cardiac Electrophysiology

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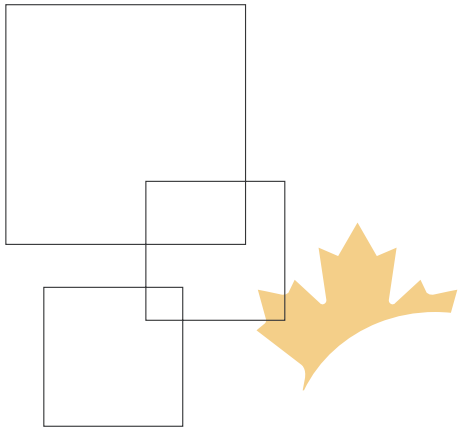

Canadian Heart Rhythm Society
Société canadienne de rythmologie

Canadian Cardiovascular Society
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Preamble

Cardiac electrophysiology has undergone significant evolution in the last decade, and is one of the fastest growing subspecialty areas in cardiology. This subspecialty focuses on diagnosis and management of cardiac arrhythmias. It is recognized that the technical and cognitive skills required for performance of cardiac electrophysiology are considerable and take extensive time and training to acquire. Fellowship includes training in appropriate history, investigation and ECG diagnosis of arrhythmia, understanding mechanisms of arrhythmias, pharmacologic management of arrhythmias, and catheter ablation, as well as patient selection, implantation techniques, complications and management for pacing, ICD and cardiac resynchronization therapy. In addition, training should include diagnostic techniques and evaluation of inherited arrhythmia syndromes.

The last training statement issued by the Canadian Cardiovascular Society Committee on Standards was published in May 1996[1]. Since this time, the field has changed significantly, and newer training guidelines should reflect these changes. Knowledge about the mechanisms, causes and risk factors for arrhythmias has evolved greatly, leading to new diagnostic and therapeutic options for patients, particularly in the area of genetic testing. Novel tools and techniques such as 3-dimensional mapping have allowed electrophysiologists to map and ablate increasingly complex arrhythmias that were previously managed with pharmacologic or device therapy. Finally, device therapy has become increasingly important with the increase in defibrillator implants due to primary prevention indications and with the availability of resynchronization therapy for heart failure patients.

Adult Clinical Cardiac Electrophysiology Fellowship training is currently occurring in 15 programs across the country with more than 40 current trainees in Canada. In general, EP fellowship training programs are 2 years, although some variation exists across programs (and some variation due to trainees' prior experience). There is currently no certification for this subspecialty in Canada, although there is an EP exam in the United States and one in Europe. Canadian trainees are not eligible to write the American Board of Internal Medicine (ABIM) Clinical Cardiac EP exam because Canadian EP training programs are currently not accredited by the Accreditation Council for Graduate Medical Education (ACGME). The Canadian Heart Rhythm Society and the Canadian Cardiovascular Society are proposing the present set of updated training guidelines.

Basis for Guidelines

The current guidelines attempt to define the education, training, and experience required for trainees to acquire the proper cognitive and technical skills related to the field of cardiac electrophysiology. These skills were developed based on the CanMEDS physician competency framework as outlined in Table 1. Since many areas of electrophysiology are interventional in nature, acquiring requisite procedural skills is an important part of the training program. It is recognized that different fellows may acquire technical skills at somewhat different rates. As a result, the evaluation of technical skills should not be based simply upon the number of procedures performed. Ultimately, the Program Committee and Program Director should be responsible for evaluation of technical skills acquired by each trainee. Nevertheless, there is a certain minimum number of procedures required in order to have adequate exposure to techniques and complications of EP procedures and device implantation required to training, experience, education, cognitive and technical skills, and these are defined in this document.

The justification for these guidelines is based on numerous sources. In addition to the 1996 Canadian Standards for Training and the CanMEDS framework cited above, similar training guidelines from other international societies were reviewed. In particular, the following documents, position statements, and policies were analyzed: the American Board of Internal Medicine Clinical Cardiac Electrophysiology Policies[2], the report of the Task Force on

Training in Specialized Electrophysiology, Cardiac Pacing, and Arrhythmia Management[3], the Clinical Competence Statement of the ACC and AHA[4], and the Core Curriculum for the Heart Rhythm Specialist of the European Society[5]. The Canadian Heart Rhythm Society has held workshops, conference calls, and face-to-face meetings with electrophysiology training directors for the last two years to help define these guidelines for training, and the Standing Committee on Training and Education defined the attached curriculum. Suggested procedural numbers for training that are listed in this paper are all consistent with the recommendations made in the aforementioned papers.

Although certain areas of cognitive and technical skills may be found in other specialties or training tracks (such as internal medicine, genetics, general cardiology or surgery), the current document seeks to define those competencies which, as a whole, define the clinical cardiac electrophysiologist. As such, this document will focus exclusively on the objectives necessary for training a candidate for Level 3 competency as a cardiac electrophysiologist.

Program Entry Requirements

EP fellows should have completed Cardiology core training at an institution with Royal College certification or equivalent. Knowledge of diagnosis and management of arrhythmia is considered part of core training in Canada and this core knowledge is a prerequisite for any EP fellowship program. The ability to function as a cardiologist should be an absolute prerequisite for cardiac EP training. Patient management issues such as heart failure, ischemic heart disease, hypertension, and stroke prevention all intersect with arrhythmia management. The ability to perform an appropriate history, physical examination and conduct appropriate investigations related to cardiovascular symptomatology or disease is assumed to be integral to Cardiology training. This document explores the further skills required for specialized training in the diagnosis and management of arrhythmia patients.

Program Requirements

There must be sufficient resources including teaching faculty, the number and variety of patients, physical and technical resources, as well as the supporting electrophysiology facilities and services necessary to provide the opportunity for all residents in the program to achieve the educational objectives and receive full training as defined by the specialty training requirements described in this document. Any cardiac EP program must have the faculty, facilities and the program structure for training and continuous evaluation of trainees. The minimum duration of training for complete EP and device training is 2 years.

a. Faculty: There must be a sufficient number of qualified and dedicated teaching staff to supervise fellows at all levels and in all aspects of electrophysiology and provide teaching in the basic and clinical sciences related to this field.

b. Goals and Objectives: All EP programs must have a set of specific goals and objectives for their program. These goals and objectives must be consistent with the EP Core Curriculum Training document and must follow the CanMEDs outline.

c. Program Structure: Each program must have a program director and a program committee. This committee is responsible for the curriculum and for evaluation of each fellow. The program director is responsible for regular interviews of fellowship trainees and evaluation and feedback on the fellow's performance. The program director and committee are responsible for ensuring that each fellow has adequate training in the technical skills required in the EP field. The program committee is responsible for regular rounds that would include EP staff and fellows. These rounds should include:

   - Review of intracardiac tracings with discussion of interpretations and various methods of proof of mechanism and site of origin of tachycardias

- Review of arrhythmia related ECG tracings
- Review of implanted intracardiac device (e.g. ICD/CRT) interrogation interpretation and programming methodology discussion
- Critical review of publications related to cardiac arrhythmias diagnosis or treatment (Journal Club)
- Review of adverse patient outcomes, including complications of EP or implanted device related procedures, unexpected deaths and adverse outcomes related to clinical decision making.

The program committee will be responsible for ensuring that each trainee has an adequate opportunity to participate in the evaluation of arrhythmia patients in many settings. These include inpatients, postoperative patients, outpatients and patients with potential inherited arrhythmia syndromes. Participation in patient care in the EP laboratory setting without adequate participation in the preliminary evaluation that determines which, if any, procedure should be planned is not considered to be adequate training.

d. Facilities: Any EP training Program must have adequate numbers of patients and procedures to allow the trainee enough patient management experience. Fellows need to have adequate exposure to patients with arrhythmia management issues and to procedures related to arrhythmia management. This should include one or more EP laboratories equipped to perform simple and complex ablation procedures, a pacemaker/ICD/CRT implantation and follow-up program, and inpatient and outpatient consultation program. Fellows should have the opportunity to observe and participate in EP studies using advanced mapping systems and perform complex device implantation. It is possible that trainees will need to gain exposure to some components of their required training in another program.

Specific Objectives of Training

Table 1 outlines the different skills and competencies required for a clinical electrophysiologist using the CanMEDs template. In general, the different cognitive skills can be classified under 4 headings: Basic and Clinical Electrophysiology; Implantable Device Therapy (Pacemakers and Defibrillators); Invasive Electrophysiologic Studies and Ablation; and Advanced Electrophysiology Techniques. Cognitive skills are acquired both by experience in clinical care on the wards, outpatient clinic, and in the EP lab as well as by instruction in rounds and other structured sessions.

Many of the cognitive skills will be acquired by discussion with staff and colleagues and attendance and presentation at rounds. In addition, participation in a structured research project will develop the skill to critically appraise the science behind clinical guidelines and clinical decision-making. The program committee should be responsible for ensuring that the necessary knowledge and cognitive skills are reviewed at rounds and Journal Clubs. The curriculum should include strategies to review all of the critical components outlined in Table 1. These strategies would include opportunity to review knowledge acquired by clinical care pathway as well as knowledge and skills to review components via more structured learning sessions.

Technical skills are likewise important in an electrophysiology training pathway since interventions (electrophysiology studies, ablations, and device implantation) are part of what defines this area of expertise. For this reason, interventions performed with the assistance and eventually under the supervision of electrophysiology faculty need to be monitored, documented and analyzed for training purposes. Table 2 lists the technical skills that are required for an electrophysiologist. As technical proficiency increases with the number of procedures performed[6-10], a guide for the minimum number of procedures required for training is included for each of the different techniques performed in electrophysiology (Table 3).

1. Basic and Clinical Electrophysiology

The following are some of the cognitive skills that define the consultant in electrophysiology as an expert in areas of rhythm diagnosis and management (particularly pharmacologic management).

- An understanding of the anatomy and cellular/subcellular physiology of the cardiac conduction system and accessory pathways
- An understanding of the accepted and major proposed basic mechanisms involved in the genesis of normal cardiac rhythm and in the pathogenesis of disorders of impulse formation, conduction, reentry, triggered activity and automaticity
- An understanding of the pharmacology and pharmacokinetics of antiarrhythmic drugs, accepted classifications of antiarrhythmic drugs, and interactions between drugs and cardiac implantable devices
- Knowledge of the different arrhythmia disorders (including bradyarrhythmias, tachyarrhythmias, syncope and autonomic disorders) as well as their epidemiology, diagnosis and management/treatment
- Knowledge of the inherited arrhythmia/sudden death syndromes as well as their epidemiology, diagnosis (includes genetic testing and family screening) and management/treatment.

2. Implantable Device Therapy

CIED (cardiac implantable electrical devices, i.e. pacemakers, defibrillators and implantable monitors) are implanted not only by electrophysiologists, but also by cardiologists, surgeons and cardiac surgeons in different settings making this a shared technical skill set. The cardiac electrophysiologist is expected to have cognitive skills for selecting patients for CIED therapy; knowing the indications, contraindications and possible complications of such therapy; and also manage the follow-up of these patients (including troubleshooting of devices, recognizing replacement indicators, and managing device advisories/recalls). The following competencies are therefore a part of electrophysiology training:

- Knowledge of the principles of cardiac pacing and the common nomenclature for pacing modes
- Knowledge of pacing algorithms, programming, CIED-induced or mediated arrhythmia, clinical implications of these algorithms, and troubleshooting for CIED
- Expertise in risk assessment of the patient with cardiac arrhythmias or at risk for cardiac arrhythmias
- Expertise in the clinical assessment of patients for CIED therapy with knowledge of key randomized controlled trials in device therapy for bradycardias and tachycardias and their relevance to clinical practice, knowledge of consensus guidelines relevant to CIED therapy, and expertise in the work-up and management of patients with tachyarrhythmias or bradyarrhythmias, and of patients at risk for either.
- Expertise in the assessment of patients for cardiac resynchronization including assessment of heart failure, knowledge of relevant clinical trials and consensus guidelines, and interpretation of ancillary testing relevant to this assessment (echocardiography, other modalities of synchrony assessment)
- Expertise in the programming of CIEDs for arrhythmia detection, discrimination of ventricular from supraventricular arrhythmias, avoidance of inappropriate pacing/shocks.

3. Invasive Electrophysiologic Studies and Ablation

In many respects, the addition of the cognitive and technical skills necessary to perform invasive EP studies and ablation to the aforementioned competencies serves to define the clinical cardiac electrophysiologist. Few of the competencies listed below are taught within the context of a general cardiology training program and therefore must be acquired within a structured EP training program.

- Detailed knowledge of the principles, indications, contraindications, potential complications and follow-up of both diagnostic electrophysiologic studies and transvenous catheter ablation for treatment of arrhythmias
- Expertise in performing and interpreting diagnostic electrophysiologic studies
- Expertise in performing transvenous and arterial catheter ablation for treatment of arrhythmias.
- The above two points include obtaining expertise in venous and arterial access, catheter positioning, programmed electrical stimulation, endocardial mapping and transeptal punctures as required
- Expertise in the recognition and management of complications related to either diagnostic EP studies or ablation.

4. Advanced Electrophysiology Techniques

The advent of new technologies has allowed electrophysiologic techniques to progress significantly in the past decade. Ablation of more complex anatomic substrates such as those encountered in atrial fibrillation or ventricular tachycardia has benefitted greatly from these advances. It is unlikely that a candidate can become proficient in every one of the following advanced techniques during the course of a standard training period. However, the candidate should be exposed to these techniques in order to gain insight into when they could be indicated, permitting the candidate to be a better clinical decision-maker. The candidate may choose to obtain further training in any of these specialized techniques. Since EP is an evolving specialty, some of the modalities listed below may change over time (become further developed, enter mainstream practice or even become obsolete!). It is therefore important that training programs perform a critical appraisal of advanced technologies with their trainees and give them the cognitive skills to utilize these modalities appropriately. This aspect of training needs to be revised periodically.

- Knowledge of the utility, indications, and potential pitfalls of three-dimensional mapping systems when performing complex ablations.
- Knowledge of the different imaging modalities that can be useful in complex ablation procedures such as CT scan, cardiovascular magnetic resonance imaging, and intracardiac echocardiography.
- Detailed knowledge of the indications, contraindications, success rates and potential complications associated with atrial fibrillation ablation. This technique has evolved considerably and become very widespread in recent years, such that it is now considered part of regular training. In a recent survey of US-based EP program directors, the vast majority (88%) believed that trainees should be competent in complex mapping and ablation procedures and 69% thought they should be competent in atrial fibrillation ablation[11].
- Detailed knowledge of the indications, contraindications, success rates and potential complications associated with ventricular tachycardia ablation.
- Knowledge of the different catheter types and energy sources for ablation (including cryoablation and its indications, success rates, and limitations).

- Whereas device lead extraction is performed in relatively select centers and the trainee may not be exposed to sufficient cases to gain technical proficiency in the procedure, he/she should possess detailed knowledge of the indications, contraindications and complications associated with this technique.
- Knowledge of the different arrhythmias encountered in the congenital heart disease population and of the available treatment options (including ablation). As this is still a relatively new area of interest, candidates may not necessarily be exposed to these types of ablations (few are performed across the country), but should know about their indications.
- Knowledge about the potential uses of remote magnetic navigation.

Evaluation

The formal evaluation process is currently under development. Evaluation tools will include oral exams, written exams (short answer and multiple choices), 360 degree feedback, and direct observation of clinical skills. While each tool may not directly evaluate each of the CanMEDS competencies (medical expert, communicator, manager, health advocate, scholar, professional), the formative and summative evaluation process will ensure all areas are adequately covered.

In order to objectively evaluate candidates based on the present guidelines for training, an in-training evaluation report assessing each of the CanMEDS competencies should be filled out by the program director at least every 3-6 months and reviewed with the trainee, and a final in-training evaluation report must be completed at the end of training. In addition to this, the candidate and the program director must keep a log/portfolio containing the following information: date, patient ID, patient age, indication, type of procedure, findings, success rates and complications. These must also be discussed and an evaluation of progress must be made with the program director at regular intervals. Each program is encouraged to hold regular morbidity and mortality rounds where procedural complications can be reviewed and the group can formulate strategies for avoiding such complications (this must be done without identifying the patients or trainees).

The trainee is also encouraged to use this portfolio to note for his/her own benefit the number of consultations (in-patient and out-patient) that were done during the training period and the number of device interrogations, cardioversions, and tilt table tests performed.

Reentry Criteria and Maintenance of Competence

Candidates already in clinical practice who wish to obtain Level 3 training in clinical cardiac electrophysiology are subject to the entry requirements described previously. In summary, the candidate must be a practicing cardiologist with Royal College accreditation (or its equivalent). Maintenance of competence in cardiology must be demonstrated before entry into Level 3 training in electrophysiology.

At present, maintenance of competence for cardiologists is assessed by the Royal College of Physicians and Surgeons of Canada which surveys members on continuing medical education activities, and this would obviously apply equally to cardiologists practicing in the field of adult clinical cardiac electrophysiology. It is proposed that electrophysiologists continue to meet these same Royal College standards. Training sessions and rounds specific to electrophysiology as well as international specialty conferences in the field are to be favoured in terms of CME activities. Since many of the skills (both cognitive and technical) are maintained through exposure to the clinical problems encountered and the interventions performed, it is essential that continued practice in the field of electrophysiology be demonstrated. This may take the form of hours or days per week dedicated to the practice of electrophysiology or ongoing procedural logs showing ongoing performance of EP procedures/interventions. Evaluation of outcomes should be performed on an annual basis.

Table 1: Skills and Competencies in Adult Clinical Electrophysiology

Strategies

Roles:	Clinical Care	Structured Instruction
Medical expert/ Clinical Decision-Maker	1. Knowledge of current indications and contraindications for an electrophysiology study 2. Knowledge of potential complications with EP studies and management of such complications 3. Knowledge of various methods of programmed electrical stimulation 4. Ability to measure conduction intervals and refractory periods; knowledge of their significance in normal and pathological states 5. Knowledge of the predictive value of EP-testing in patients with various arrhythmias and clinical syndromes 6. Ability to interpret data derived from EP testing 7. Knowledge of the indications for and complications of therapy with antiarrhythmia devices 8. Knowledge of the indications for and complications of ablative therapy 9. Detailed knowledge of recent clinical trials that affect the selection of patients for EPS 10. Indications for pacemaker 11. Indications for ICD and/or CRT. 12. Review of implant techniques, including coronary sinus lead placement 13. Knowledge of performance, complications of and contraindications to defibrillation threshold testing 14. Knowledge of external defibrillation/cardio-version techniques 15. Programming and troubleshooting of pacemakers, ICD's and CRT devices. 16. Knowledge of implantable device emergencies 17. Knowledge of indications and contra- indications of tilt-table testing – protocol of administration and interpretation of results 18. Knowledge of radiation safety protection for staff and patients	1. Know normal and abnormal cardiac anatomy and electrophysiology. 2. Know anatomy and physiology of the normal atrioventricular conduction system and accessory pathways. 3. Understanding of intra-cardiac electrocardiographic signals. 4. Understand the pathogenesis of cardiac arrhythmias including • primary electrophysiology • abnormalities and secondary • causes of rhythm disturbances 5. Know the pharmacology of antiarrhythmic drugs and of sympathetic and para-sympathetic antagonists 6. Know the causes of syncope 7. Understand the basic concepts of artificial pace-maker function 8. Understand the concept of proarrhythmia 9. Be able to interpret Holter recordings and event monitor recordings 10. Be able to interpret intracardiac device interrogation including electrograms 11. Understand the advantages and limitations of genetic testing in patients and families with inherited arrhythmia syndromes of sudden death 12. Understand the investigations and management of inherited arrhythmia syndromes in patients and their families.

Roles:	Clinical Care	Structured Instruction
Communicator	1. Be able to inform the patient and their family about their problem, its prognosis, management and plans for follow-up 2. Communicate with the health care team regarding the patient management plan 3. Be able to write consultation/ discharge letters to referring physicians 4. Prepare the final EP study reports 5. Be able to explain the different electrophysiology interventions to patients (EP study, ablation, device implant) and obtain informed consent for each of these 6. Be able to communicate and explain to patients the issues regarding the different device advisories and recalls and management thereof	1. Participate actively in teaching sessions 2. Prepare and present rounds as scheduled 3. Active participation in patient education (example post procedural counseling for wound care)
Collaborator	1. Work with the house staff team in the care of patients 2. Act as consultant for outpatient and inpatient management of patients with arrhythmia problems 3. Participate in the performance of the EP study 4. Understand and support the roles of allied health professionals (nurse, EP technologist) in the EP lab and device clinics 5. Work closely with other health care professionals whose patients require specialized arrhythmia care (examples: heart failure specialists, geneticists and genetic counsellors)	1. Contribute to organized rounds 2. Participate in ongoing clinical trials where applicable
Scholar	1. Recognize gaps in knowledge regarding patient problems and develop strategies to fill the gap through reading and consulting other members of the healthcare team 2. Contribute knowledge learned to service rounds	1. Read the suggested articles 2. Critically review relevant published material at Journal Club 3. Participate in and understand arrhythmia research project
Professional	1. Deliver care with integrity, honesty and compassion 2. Understand the professional, legal and ethical codes to which physicians are bound 3. Obtain informed consent for the different EP procedures	

Table 2 Technical Skills Acquired During Electrophysiology Training

1. Ability to gain venous and arterial access with via femoral and other venous sites
2. Skills to safely position intracardiac catheters and perform endocardial mapping of the different cardiac chambers
3. Ability to safely perform programmed electrical stimulation
4. Ability to recognize and manage procedural complications
5. Proficiency in the use of external defibrillation and intravenous cardiac medications
6. Proficiency in the appropriate use of sedation during procedures, including airway management
7. Proficiency in the testing, interrogation, and programming of implantable antiarrhythmia devices, including pacemakers and defibrillators (this includes programming devices for resynchronization therapy)
8. Proficiency in implanting cardiac devices such as pacemakers, defibrillators, and loop recorders. The candidate should also be proficient in implanting coronary sinus (left ventricular) leads for resynchronization devices
9. Technical knowledge of electrical safety and pertinent radiation-related issues

Table 3 Suggested Procedural Numbers

Suggested Procedural Numbers
1. Primary operator and analysis of 100-150 diagnostic EP studies, of which 50 involve patients with supraventricular arrhythmias
2. Performance of at least 50 ablations for SVT
3. Primary operator of at least 75 pacemaker/ICD implantations at least 25 of which should be ICD's and at least 20 revisions
4. Performance of at least 15 coronary sinus (LV) lead placements for CRT
5. Supervised performance of at least 20 transseptal punctures
6. For left sided procedures, at least 10 procedures using the retrograde aortic approach
The following are recommendations for more complex ablation EP procedures
1. For training in AF ablation, 30-50 supervised ablations
2. For training in complex flutter ablation, 15-20 procedures
3. For training in scar-related VT ablation, 15-20 procedures

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