SECTION 18

Nephrology in the future

CHAPTER 365

A global curriculum for training the next generation of nephrologists

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Introduction

Academic training programmes should provide both structured resources and a process of continual professional development in order to ensure that a physician can practise their chosen specialty independently and competently. In many countries around the world, nephrology training has evolved from the traditional apprenticeship model to a well-defined formal fellowship. In this way, nephrology training encompasses acquisition of knowledge and skills, broad clinical exposure, literature review, and research experience which collectively equip the trainee with the skills needed to safely manage patients with a comprehensive range of renal disorders. An ideal curriculum should also include epidemiological and population perspectives and be flexible in allowing modifications to add regionally relevant components in different parts of the world.

Basic curriculum

Wadi Suki (1975) and Eli Friedman (1975) published the earliest papers on the academic and clinical content of North American nephrology fellowships in 1975. The Education Advisory Committee of the International Society of Nephrology (ISN) produced guidelines for Postgraduate Training of Nephrologists in 2001, which were endorsed by the Council of the ISN in 2002. Unlike other more detailed published curricula and textbooks, the ISN Core Curriculum was intended as a guide to the elements which should be expected in training programmes in developing as well as developed nations (ISN, n.d.). A broad outline for nephrology curriculum is provided in Box 365.1, and expanded upon subsequently.

Goals of training

Successful completion of postgraduate training in nephrology should make the trainee competent to provide independent, consultant-level, comprehensive care in nephrology. In addition, the trainee should acquire the generic attributes expected of a consultant physician (ISN, n.d.), including:

- high personal and professional ethical standards
- a patient-centred approach to practice
- a commitment to provide service and care to patients of all age groups and sociocultural backgrounds
- an ability to work with colleagues in a multidisciplinary team
- a willingness to devote time to teach students and junior colleagues
- a commitment to continuing professional self-education.

Syllabus to set training targets

Several published nephrology curricula are available (Kumar et al., 1997, Linas, 2003; Kliger and Schmidt, 2009; Niyyar and Work, 2009 Perl and Chan, 2009; Avery, 2010; Perazella, 2010; McMahon and Waikar, 2013; European Society for Paediatric Nephrology, n.d.; Royal Australasian College of Physicians, n.d.). At a minimum, the knowledge and clinical skills acquired during a nephrology fellowship should cover (adapted from the *ISN Core Curriculum*, 2003):

Knowledge

1. Basic renal sciences: anatomy, growth and development, genetics, and physiology of renal function.
2. Renal pathology, pathophysiology, immunology, and microbiology.
3. Clinical manifestations and natural history of renal diseases and hypertension.
4. Investigation and diagnosis of renal disease and hypertension.
5. Treatment of renal disease and hypertension.
6. Management of end-stage kidney disease with conservative therapy, dialysis, and renal transplantation.
7. Clinical epidemiology, prevention, and population health.
8. Miscellaneous: ethical issues, advocacy, public education, and economics of effective renal care.

Clinical skills

1. Perform a complete clinical history and physical examination of a patient presenting with renal disease and/or hypertension (to include digital rectal examination and fundoscopy).
2. Integrate all clinical and investigative findings into a coherent diagnosis, with formulation of a differential diagnosis, management plan, and prognosis.

Box 365.1 Essential elements of a nephrology training curriculum

- Goals of training
- Syllabus to set training targets
- Patient- and population-based competencies
- Required knowledge and skills
- Competency assessment
- Methods of learning
- Resource materials.

3. Perform a dipstick urinalysis, and fresh urine microscopy to detect cellular elements, crystals, and casts.
4. Perform a percutaneous biopsy, under local anaesthetic, of a native and transplanted kidney.
5. Place temporary intravascular lines for haemodialysis access.
6. Connect a patient to the haemodialysis circuit [desirable].
7. Place an acute peritoneal catheter [optional, as required by conditions].
8. Place a Tenckhoff catheter (or equivalent) for commencing chronic ambulatory peritoneal dialysis [optional].
9. Perform a urinary tract ultrasound examination [desirable].
10. Assess and manage a poorly functioning vascular access.
11. Interpret native and transplant kidney biopsies and urinary tract and dialysis access imaging [desirable].

Adequate exposure to permit satisfactory acquisition of these clinical skills may not be uniformly available. For example, in Australia, a recent increase in the number of nephrology trainees and reduced working hours has meant that exposure to skills for individual trainees is now substantially less than a decade ago (Amos et al., 2013).

Competency assessment

Traditionally, except for written tests, competency assessment in medical education has been subjective and dependent on individual faculty opinion and experience. This variable approach suffers in its inability to produce uniformly competent physicians (Kohn et al., 1999) whilst, in many other countries, there are no formal processes for competency assessment. Competency assessment is a fundamental component of nephrology training and ideally should be objective to ensure uniform training experience (Parker, 2010). To this end, the Accreditation Council for Graduate Medical Education (ACGME) in the United States has implemented six general competency categories in postgraduate training programmes.

1. Medical knowledge—demonstrated in the biomedical, clinical, epidemiological, and social-behavioural sciences.
2. Patient care—providing compassionate, appropriate, and effective care.
3. Practice-based learning and improvement—ability to investigate, appraise, assimilate scientific data, self-evaluate constantly, and engage in life-long learning.
4. Interpersonal and communication skills—ability to effectively exchange information and collaborate with families and other health professionals.
5. Professionalism—commitment to carrying out professional responsibilities and adhering to ethical principles.
6. System-based practice—awareness of larger context of healthcare and effective use of available resources.

Provision of feedback to the trainee using multiple objective assessment tools and evaluations is the subject of an ongoing project implemented by ACGME. Trainees are provided periodic feedback and are assessed in multiple ways such as direct observation, evaluation by peers, self-assessment, chart documentation review, in-training examination, and board certification examination.

In Australia and New Zealand, the Royal Australasian College of Physicians has developed the Physician Readiness for Expert Practice (PREP) programme, a comprehensive system of formative education for the 3-year, advanced training programme in Nephrology (Royal Australasian College of Physicians, n.d.). The basic guiding principles include a supportive learning environment, a learner-centred approach, and reflective practice. An educational framework is provided by two curricula, a Nephrology Advanced Training Curriculum and Professional Qualities Curriculum, and training is overseen by at least two individual supervisors. Teaching, learning, and assessment tools are fundamental and include:

- learning needs analyses (LNA)
- case-based discussions (CbD)
- mini-clinical evaluation exercises (mini-CEX)
- training projects, including a research component
- procedural logbooks and direct observation of procedural skills (DOPS).

In 1996, the minimum standards for training in nephrology were published by the European Union of Medical Specialists programme (Lappin et al., 1996, 2013). Over the years, the expansion of the European Union (EU) prompted the need to synchronize and develop an updated programme addressing the need for a common framework for nephrology training across EU countries. The programme outlines a minimum 2 years training in general medicine followed by a structured training of at least 3 years of supervised clinical practice in nephrology, and a final year in either nephrology, general medicine, a related specialty, or research. The nephrology training and learning includes similar components as outlined above involving a thorough understanding of pathophysiology and the physical and psychosocial impacts of various diseases affecting the kidneys, and eventually becoming an expert in the management of these disorders. Providing appraisals with ongoing feedback during the training years is considered an integral part of the curriculum.

In 2010, the Joint Royal Colleges of Physicians Training Board of the United Kingdom developed a Specialty Training Curriculum for Renal Medicine and later updated it in August 2012 (Joint Royal Colleges of Physicians Training Board, 2012). The updates incorporated the importance of obesity and transition of care from adolescence to adult renal services. The duration of training was aligned with the EU directive developed for flexible training (EU directive 2005/36/EC). Specialty training in renal medicine in the United Kingdom requires completing 2 years of Core Medical Training followed by 3 years of training in renal medicine leading to a completion of training certificate award. The provision to complete the training with less than full-time training is a unique option available in the United Kingdom without compromising the competencies. The training covers domains including knowledge, skills and performance, safety and quality, communication, partnership, and teamwork. The curriculum includes special circumstances such as caring for transition of adolescent patients to adulthood, nutrition

in renal disease, sexual health issues, and end-of-life care. The tools for assessment involve case-based discussions, mini-CEX, DOPS, audit assessment, and examinations and certifications leading to the Specialty Certificate in Renal Medicine (Membership of the Royal Colleges of Physicians of the United Kingdom, n.d.).

Methods of learning

Traditional methods of learning and assessment

In general, the overall philosophy of physician training is to empower the trainee to provide competent patient care under supervision, leading eventually to responsibility for independent decision-making. Depending on local expertise and available facilities, the following educational methods may be employed in the implementation and assessment of the curriculum (ISN, n.d.):

- Self-directed learning by use of library materials (texts and journals) and online resources.
- Participation in Journal Clubs or equivalent formats to maintain familiarity with current clinical trial evidence and new advances.
- Formal teaching by didactic lectures, tutorials, or demonstration sessions.
- Case presentations and discussions with supervisor and clinical department members.
- Maintenance of a logbook of cases managed and procedures performed.
- Assessment of trainee competence utilizing more than one of the following tools:
  - multiple choice questions/in-training examinations
  - modified essay questions (case-based)
  - review of clinical records kept
  - observation of consulting and procedural skills by senior colleague(s)
  - survey of observations of trainee performance made by colleagues, non-medical staff, and patients.

Contemporary methods of learning

The increased workload arising from the worldwide epidemic of chronic kidney disease superimposed on shortages in the nephrology workforce has stretched postgraduate education programmes (Kohan and Rosenberg, 2009; Bernis Carro and Comisión Nacional de la Especialidad de Nefrología en España, 2011; Parker et al., 2011; Suarez, 2011).

Moreover, economic pressures of healthcare delivery, reduced clinical exposure for trainees (Amos et al., 2013), and intolerance of inefficiencies in postgraduate medical education have resulted in new challenges for nephrology training programmes. The growth and impact of the Internet is evident in medical education and fills training deficiencies to some extent. Integrating web-based learning resources in medical education has been shown to improve satisfaction and facilitate learning efficiencies (Bridgemohan et al., 2005; Cook et al., 2008).

Web-based instructions are self-paced tutorials, often interactive and in various formats (webcasts, podcasts, e-learning modules, electronic textbooks), and have enhanced the learning experience substantially (Choules, 2007). Internet-based learning offers several advantages over traditional classroom-based methods. The key advantages are 24-hour availability and the easy dissemination and sharing of the knowledge among various collaborating groups and countries. It offers different learning platforms for different teaching and learning styles. Internet-based medical education has been found to be an effective tool and is associated with improvement in learning outcomes, such as learner's satisfaction, knowledge and skills acquisition, and effects on patient care (Mohanna, 2007; Cook et al., 2008; Cook and Levinson, 2010). Adult learning is often handicapped by a short attention span and biased by previous clinical experiences. Internet-based education tools offer the advantages of learning at an individualized pace, self-selection of content, and its trainee-centred rather than trainer-centred approach (Alur et al., 2002; Ruiz et al., 2006). There are, however, several disadvantages of Internet-based learning, the most significant being the initial cost of establishing reliable and high-quality resources. Moreover, updating the information and maintaining these sites requires effort, time, and money. Finally, technical problems related to Internet connectivity, software, and viruses can often lead to frustration (Wolbrink and Burns, 2012).

Over recent years, Internet-based educational tools in nephrology have evolved considerably and should be integrated into training curricula for the next generation (Buettner and Fadem, 2008; Desai et al., 2011). These include the following:

ISN Education website

This website provides a compilation of resources that are relevant for learning nephrology (http://www.theisn.org/education-home/nephrology-internet-resources).

UpToDate©

This is peer-reviewed, non-interactive, text-based information and requires expensive membership subscription (http://www.uptodate.com).

Blogs

A blog is an online journal written by either a single person or a group of contributors. The content of a blog includes commentaries, polls, learning through games such as crossword puzzles, links to references, embedded or attached images, and video files. A blog offers interactive discussions amongst readers. Nephrology-related blogs have been compiled and published in the *American Journal of Kidney Diseases* (Sparks et al., 2011).

Wikis

Wikis offer sharing of information, permit dialogue, and allow free access to editing. The contents are well organized, providing easy navigation and search potential. The most widely known wiki is Wikipedia (http://www.wikipedia.org). Nephrology-related wiki are few and still in the early development phase.

Podcasts and YouTube

These formats allow the creation of multimedia content and the addition of voice and images, making it very user-friendly. The contents can be easily downloaded on multiple devices such as smartphones or MP3 players. The American Society of Nephrology offers podcasts on their learning tool NephSAP and ASN Kidney News (http://www.asn-online.org). YouTube videos dedicated to nephrology topics are available on a Canadian education site (http://www.Ukidney.com) and the ASN Media Library (http://www.asn-online.org/media/videos.aspx). The ISN Education website (http://www.theisn.org/education) has an expanding compilation of resources for the learner.

Kidney schools

Online kidney schools offer a one-stop learning tool. Global Online Academy (http://www.gkaonlineacademy.com) offers case discussions, interactive forums, blogs, literature review, lectures, and journal abstracts. In Australia and New Zealand, Kidney School (http://www.nephrology.edu.au/kidneyschool) offers monthly web conferences and case-based workshops, in addition to an online library of past seminars. Several clinically relevant resources such as medical calculators and a topic-based library are readily available for both trainees and practitioners. Other similar resources have been developed to promote e-learning in nephrology, including Ukidney (http://www.Ukidney.com), Nephrology On-Demand (http://www.nephrologyondemand.org—now also available as a mobile app) and Hypertension, Dialysis, and Clinical Nephrology (http://www.HDCN.com). These sites also provide updates on various meetings across the globe.

Videos and lectures

Training videos and mini-lectures with focused learning objectives are a frequently used platform for e-learning. ISN Education (http://www.theisn.org/education) has several videos highlighting the steps involved in various procedures relevant to dialysis. Mini-lectures with synchronized audio-visual PowerPoint presentations are very popular and well received by the users of this website. Similar resources are also available on the European Renal Association website (http://www.ndt-educational.org/).

Simulation models

Simulation using virtual patient scenarios provides an opportunity to learn new skills and use them in a safe environment. Simulation-based physiology training and teaching can also be useful. The understanding of electrolyte and acid–base disorders was shown to improve significantly when similar tools were used for learning (Davids et al., 2011). A high-fidelity haemodialysis simulation programme introduced in a Queensland dialysis unit provides a realistic, safe, and controlled learning environment to develop essential haemodialysis related competencies (Dunbar-Reid et al., 2011). Simulation models will play a significant role in training related to endovascular procedures for dialysis vascular access. Simulation courses focusing on dialysis vascular access and peritoneal dialysis catheter insertion are offered at various nephrology meetings across the globe (e.g. World Congress of Nephrology, American Society of Diagnostic and Interventional Nephrology, and European Renal Association–European Dialysis and Transplantation Association).

Box 365.2 Examples of regional disease variations mandating greater emphasis

- Distal renal tubular acidosis which has a high prevalence in tropical countries, particularly Thailand, Malaysia, Philippines, and Papua New Guinea (Khositseth et al., 2012). (See Chapter 36.)
- Renal stone disease which also has a higher prevalence in tropical countries.[37] (See Chapter 199.)
- Infection-related urinary tract disorders such as schistosomiasis which are more common in African and other developing countries (Romero et al., 2010). (See Chapter 181, 182.)
- Aristolochic acid nephropathy (Chinese herb nephropathy/Balkan nephropathy), an endemic disorder in China and Balkan countries (Gökmen et al., 2013). (See Chapter 89.)
- Glomerular diseases related to tropical infections including parasitic disease and tuberculosis, which are more common causes of chronic kidney disease than in Western countries (Naicker, 2003, 2010). (See Section 8.)
- Acute kidney injury related to venoms, toxins and parasitic infections which also is more common in certain parts of the world than in developed Western countries (Sitprija, 2008). (See Chapter 241.)

Nephropathology

With advances in technology, virtual histopathology has become a popular teaching tool. High-definition images can provide real-life experience in visualizing pathology at various magnifications, with structures and abnormal findings clearly annotated by the instructor. The images can be uploaded into cyberspace for easy access over the Internet from anywhere in the world. ISN Education (http://www.theisn.org/education) is compiling a teaching library of interesting cases that can be easily accessed over the Internet.

Global nephrology training

In 2001, the Education Advisory Committee of the ISN conducted a survey of nephrology training in 37 representative countries from each region of the world. Not all countries had a nephrology training programme. Most programmes required training in internal medicine as a prerequisite for training in nephrology, with a key component of nephrology in their curriculum. There were major deficiencies in some training aspects (e.g. nephropathology, transplantation, continuous ambulatory peritoneal dialysis, and continuous renal replacement therapy), especially in sub-Saharan Africa, Russia, and the Commonwealth of Independent States.

An outcome of this survey was the creation of a Core Curriculum for Postgraduate Training in Nephrology, as earlier discussed. However, a syllabus is only one step in the process of ensuring adequate training in nephrology.

Tailoring curriculum to regional training requirements

A core nephrology fellowship curriculum can be utilized as a basic framework with regional modifications according to prevalence of disease processes in individual countries. Some of these regional variations which are well recognized and mandate greater emphasis in the training curriculum are included in Box 365.2 (Barsoum, 2003; Naicker, 2003, 2010; Sitprija, 2008; Romero et al., 2010; Khositseth et al., 2012; Gökmen et al., 2013).

Effect of globalization on training

Advances of technology and development have created unique challenges for the medical profession. The ease of travelling across the globe has resulted in transfer of various unfamiliar disease processes to other parts of the world where physicians may be ill-equipped to provide adequate therapy. A fundamental shift in training, education, and research is needed to prepare the nephrology workforce of the next generation. The creation of resources that can be utilized to treat the global community will be a growing challenge that most nephrology training programmes will face in the future. Tools such as Internet learning sites (as previously mentioned) and various global outreach programmes of the ISN (including the Sister Renal Center and Fellowship and Educational Ambassador programmes) offer avenues for understanding regional disease variations and gaining familiarity with possible presentations and disease management options.

Training nephrologists from emerging countries

In many emerging countries nephrology training is rudimentary, and trainees need to seek experience overseas. As long as the training is tailored to the needs of the trainee and the home unit, the experience can be highly beneficial for the trainee, the home unit, and even the home country. The ISN's Fellowship Program has sponsored the training of more than 600 fellows from over 80 emerging countries since 1985. The outcomes of the programme have been evaluated (Harris et al., 2012), and it has been shown to be of substantial benefit for the fellows, many of whom have gone on to leadership positions. By undertaking training within the fellow's home region the relevance of the training can be enhanced and the risk of the fellow not returning home obviated.

Emerging issues

Training in nephrology is a dynamic field that should match the constantly evolving practice of nephrology. Resource constraints and changing needs of the kidney patient community have brought significant challenges that impact on both training and clinical practice. Many countries are grappling with economic pressures (related to ballooning healthcare costs, ageing populations, and stressed economies), workforce considerations (restriction of working hours, and supply and distribution of the medical workforce), and an increasing burden of chronic disease (related to ageing populations). As a result, areas of nephrology that have recently gained particular prominence include interventional nephrology, geriatric and palliative care nephrology, and prevention, early detection, and management of chronic kidney disease.

Interventional nephrology (including insertion of tunnelled haemodialysis and peritoneal dialysis catheters, endovascular procedures, and diagnostic ultrasonography) has grown rapidly in the last decade. Training in this area in particular exemplifies the evolution of medical training programmes from an apprenticeship model to an outcomes-based model. Indeed, performance-based methods, such as DOPS, are fundamental to all interventional nephrology training programmes. Simulation models are particularly useful for training and assessment of core skills. The American Society of Diagnostic and Interventional Nephrology is the largest of a number of societies and special interest groups promoting such training through establishment of practice standards, certification of physicians, accreditation of training programmes, and development of other educational tools and activities.

Ageing populations, rising healthcare costs, and recent data about outcomes of renal replacement therapy in older patients have driven global initiatives to prevent, detect, and intervene at an early stage of chronic kidney disease. These include:

- the development of relevant clinical practice guidelines (e.g. guidelines by the National Institute of Health and Care Excellence (NICE) in the United Kingdom and Caring for Australasians with Renal Impairment (CARI) in Australia)
- the establishment of World Kidney Day (http://www.worldkidneyday.org; a joint initiative of the ISN and the International Federation of Kidney Foundations)
- the establishment of screening programmes to detect early chronic kidney disease (e.g. the Kidney Evaluation for You (KEY) programme in Australia and the Kidney Early Evaluation Program (KEEP) in the United States).

The expanding fields of conservative care, palliative care, and geriatric nephrology similarly reflect the changing needs of the kidney patient community, bringing a particular focus on symptom control. Training must similarly adapt to these emerging areas of nephrology with an increasing emphasis on geriatric pharmacology, pharmacotherapy, and multidisciplinary models of care.

Conclusion

Nephrology training requires a structured programme with resources, a defined curriculum, and adequate clinical exposure to allow acquisition of knowledge and skills sufficient for safe and independent management of patients with a broad range of renal disorders. The curriculum needs to be tailored to regional requirements and match constant changes in nephrology practice. Competency assessment should be objective, comprehensive, and matched to the curriculum. Traditional methods of learning and assessment can now be complemented by more contemporary, particularly Internet-based, tools. The standard and evolution of nephrology training in many countries is sufficient to produce safe and competent nephrologists. However, in a number of developing countries, training is inadequate and requires assistance from established programmes in other countries.

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