DIALYSIS TECHNOLOGY CERTIFICATION

Ontario Association of Certified Engineering Technicians & Technologists

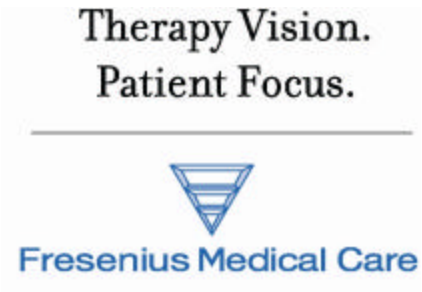
In conjunction with

The Canadian Association of Nephrology Nurses and Technologists **and**

Georgian College of Applied Arts and Technology

Study Guide

Generously supported by Fresenius Medical Care Canada



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Introduction

The purpose of this study guide is to help you in preparing for the national certification examination in Dialysis Technology. This guide, along with the suggested text resources, will assist you in reviewing concepts related to the Core Competencies in dialysis technical practice. These Core Competencies are included in the study guide for your review. It is from this document that the exam blueprint was created.

Your success on the examination will depend on your knowledge and skills in dialysis technical services and your ability to apply this knowledge and experience to the questions on the exam. The study guide will help you review core concepts and apply this to sample test questions. The guide also covers study skills and test taking strategies to help you be successful.

Certification is part of the professional's overall commitment to quality care for patients. As the role of the dialysis technician/technologist continues to expand, the need for certification will become increasingly important. We congratulate you on your decision to certify in your field of expertise and wish you every success in completion of the examination.

Best regards from the Certification Steering Committee.

Acknowledgements

The following individuals were instrumental in development of the Dialysis Technology Certification Exam Study Guide:

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A project of this importance could not occur without considerable financial support. Fresenius Medical Care Canada has generously donated funding to enable this project to come to fruition. Through this support, the cost of exam development has not been passed on to the candidate who writes the examination.

The National Certification Team wishes to acknowledge the support of Juan Sanchez, President and Gil Grenier, Director, Technical Services, both of Fresenius Medical Care Canada, for their support in bringing this project to completion.

Caveat

Every effort has been made to ensure the accuracy of information at the time of printing. Candidates use the information and suggestions in this study guide as an aid to their exam preparation. OACETT, CANNT, Georgian College and the corporate sponsor, Fresenius Medical Care Canada, do not assume responsibility for the candidates' performance on the Dialysis Technology Certification Examination.

Table of Contents

Chapter

1

Criteria for Certification

The certification process is voluntary and is intended to validate the specialized body of knowledge in the field of dialysis technology. By creating national standards in the technical field, dialysis technicians and technologists can earn the credential, Certified Nephrology Technician or Technologist (C. Neph. T.), which is licensed for use through the Ontario Association of Certified Engineering Technicians & Technologists (OACETT).

Eligibility

To be eligible to write the national certification examination for dialysis, the candidate needs to be a certified member of their provincial engineering technology association. Once certified as a Certified Technician (C Tech), Certified Engineering Technologist (CET), or Applied Science Technologist (AScT), the candidate can apply to OACETT to be considered for certification in dialysis as a technical sub-specialty. Bio-medical engineering technologists qualify to write the certification examination once eligibility criteria have been met.

Out of province candidates can apply as non-resident applicants for a nominal fee of $55. Fees are subject to change. Applicants must fulfill the OACETT requirements regarding validation of years of work experience in dialysis technical services and must provide two (2) letters of professional reference from the facility where the applicant is employed.

Fees

The examination fee is $135. This fee will include the full study guide, available on disc and mailed to the applicant when eligibility is confirmed.

Applying

Candidates can apply for the yearly writing of the certification exam by accessing the application form on the OACETT website: www.oacett.org or by contacting OACETT at: **(416) 621-9621 X 237or by Fax: (416) 621-8694.**

Location of Examination Centres

The certification examination will be offered twice each year, typically spring and fall. The fall sitting will usually coincide with the CANNT conference dates and will be written early in the conference proceedings. The number and location of exam sittings is determined yearly based on the number and location of the applicants.

Pass Mark

The pass mark for the examination is 70%.

Communication of Results

Results (pass/fail grade) will be sent to candidates by registered mail from OACETT. Successful candidates will receive an OACETT certificate, with confirmation of the designation earned. Results are not subject to appeal.

Re-write Privileges

Candidates can re-write the examination until they are successful. There is no limit to the number of re-writes allowed. Fees apply for each re-write. Each year's examination will be substantially different but consistent with the Core Competencies and Examination Blueprint. At the candidate's request a resource person can be assigned to assist the candidate with study strategies.

Protection of the Public – Complaints Review

Once a member of OACETT, the member's technical practice falls under the Code of Ethics and Rules of Profession Conduct of this organization. In the event of a complaint against the member, the process for disciplining the member follows the standard format used by OACETT.

Re-Certification

Certification is valid for five years. During this time, the candidate must accrue 75 Continuing Education Unit (CEU) hours in order to re-certify. CEU credits can be obtained through attendance at conference keynote or concurrent sessions, manufacturer's training days, in-house education seminars or through completion of self-study units available in professional dialysis journals. Candidates keep a portfolio of their CEU credits for evaluation by the Certification Team.

Chapter

2

Exam Development & Guidelines for Proctors and Candidates

The certification examination has been created by a team of senior technologists, industry representatives and educators. The team members represent all regions of Canada and is truly a national project.

Once questions are submitted, they undergo a review by an independent group to assess the quality of the questions and their compliance with the Core Competencies and Exam Blueprint. References for the correct answer(s) are checked and there is an assessment of cultural sensitivity factors to ensure that the exam is free from cultural bias. The examination is constructed yearly using questions that have validated well statistically in past writings. The exam will consist of approximately 100 – 125 questions. Questions are assigned a point value (one, two or three points) based on their degree of difficulty. The pass mark is 70%. The certification exam is written in English.

After the examination is written, statistical analysis takes place in the questions for measures of validity and reliability. Questions that do not validate well can be removed or revised for future use. A continuous intake of questions is essential for the examination to represent the most current technology used in the dialysis field. The intent of the development cycle is to ensure that the examination is fair and that it represents the current requirements of technical practice.

GUIDELINES FOR PROCTORS AND EXAM CANDIDATES

Please advise candidates of the following prior to commencement of the exam:

- Length of exam
- Bathroom Policy
- Academic integrity policy
- Procedures regarding questions

GUIDELINES FOR PROCTORS

Candidate Verification:
Candidates must present valid photo identification, e.g. driver's license, etc. Proctors must check off the names on the list of candidates provided and return this sheet to OACETT with the completed exams.

Conduct during the Exam:
Candidates should be seated 5 minutes prior to commencement of the exam. Candidates must be seated at least three feet apart. Attention should be paid to the comfort of the candidate(s). Please check on lighting, room temperature and ventilation ahead of time and request adjustments so that candidates are as comfortable as possible. Noise and other distractions are minimized.

In the event of unavoidable lateness, a late candidate will be allowed to sit the exam up to 1.5 hours after the exam has commenced. However, no additional time will be given. Cell phones and pagers are not permitted during the exam and candidates are reminded of this at the outset of the exam. Candidates are expected to conduct themselves professionally.

Candidates are allowed the use of the washroom facilities during the course of the examination. However, candidates must first ask and receive permission from the proctor to do so. Candidates must raise their hand and wait until the proctor goes to the candidate's seat to ask for permission. Candidates are not permitted to leave their seats during the exam. Only one candidate at a time will be excused from the examination room.

Questions during the Exam:
If a question is asked, the proctor goes to the candidate's seat. If they do so, the paper is returned to the proctor and the exam is considered finished. Proctors are not permitted to interpret or re-state a question on the exam or lead the candidate in any way in answering a question. Every attempt is made to keep the exam hall quiet.

It is not appropriate for the proctor to solicit comments from the candidates before or during the exam. If a candidate wishes to provide comments relative to the exam, facilities, etc. the candidate may direct these comments in writing to the Registrar of OACETT.

Academic Integrity:
All personal items (purses, brief cases) are stored away from the candidates' desk in a designated area of the proctor's choice.

Candidates are not permitted to remove exam materials from the exam room and doing so will result in a mark of zero and in possible disciplinary action. At the end of the time permitted, or when the candidate is finished, the paper is collected along with the answer sheet. Both are sealed in the envelope provided and sent by registered mail to OACETT. The proctor signs over the seal to ensure the exams arrive at OACETT in un-tampered condition. The OACETT contact information follows.

OACETT, 10 Four Seasons Place, Suite 404, Toronto, ON M9B 6H7.
Attention: Carla Jochems, Administrative Assistant

The proctor monitors and maintains the integrity of the examination process. The proctor can use his/her judgment in giving an appropriate warning to a candidate who breaks any of the rules (eg, talks, cell phone use, etc.). However, where the proctor witnesses an act of cheating or other academic dishonesty, the proctor is to immediately confiscate the candidate(s)' paper(s). The proctor must record the time of confiscation on the exam paper, tell the candidate the reason for the confiscation, and seal all the candidate(s)' exam materials in the envelope. The proctor need not give any other explanations to the candidate(s) save that the OACETT Registrar will be contacting the candidate(s) and that if they have any questions or concerns to forward them to the Registrar. The candidate is then excused from the examination. At the end of the exam session or as soon as possible thereafter, the proctor must file a report about the incident with as much information as possible to the Registrar.

Emergency Procedures:
In the unlikely event of an emergency, proctors are to ensure the safety of the candidates. Upon being alerted to an emergency, the proctor will ask all candidates to stop writing, place their exams and question paper in the envelopes, seal and leave them on their desks. The proctor will collect all papers. The candidates are then told to proceed to a safe location (as instructed by authorities) as quickly as possible and not to discuss the exam. The proctor should note the time the exam is stopped.

As soon as possible, the proctor should contact the Registrar or delegate regarding procedures to be implemented following the emergency. Depending on the situation, it may be possible to continue the examination, reschedule, or accept the current exam as complete. The proctor will need to document the emergency.

GUIDELINES FOR CANDIDATES

Verification of Identify:
Valid photo ID is required and must be available on request.

Conduct during the Exam:
You should arrive 5 minutes prior to the commencement of the exam. Write your last & first name, and OACETT membership number on the front cover sheet of the exam.

In the event of unavoidable lateness, a late candidate will be allowed to sit the exam up to 1.5 hours after the exam has commenced. However, no additional time will be given.

Answers must be entered on the computer answer sheet in pencil in case a change is needed. Completely erase any changes and all stray marks. No scrap paper is permitted. If calculations or notes are required, they are made on the back of one of the exam sheets.

Cell phones and pagers are not permitted. They should be turned off and left in your briefcase or bag.

The use of bathroom facilities is permitted, one candidate at a time, at the discretion of the proctor. No food is permitted in the exam hall.

Three hours of writing time is permitted. Leaving early (prior to 1.5 hours) is not permitted. On leaving, candidates are asked to be respectful of others who are still writing, and to leave quietly. A professional demeanor is expected during the examination.

Questions During the Exam:
If you have a question, raise your hand and the proctor will come to your seat. The proctor can re-state the question so that you better understand what is being asked. The proctor cannot read more into the question or otherwise lead your answer.

Academic Integrity:
All personal items (purses, brief cases) are stored away from the your desk in a designated area. The use of a basic, non-programmable calculator is permitted. The proctor can ask to see the functions of the calculator (if it looks like a data storage aid), to determine that it has no text storage capacity. No other electronic aid (such as a language translator), is permitted.

The use of notes, communicating with other candidates during the exam, copying from another candidate's paper, having another person write the exam, or any other acts of cheating or plagiarism will result in confiscation of the paper and a mark of zero.

Removing exam materials from the exam room will result in a mark of zero and in possible disciplinary action. At the end of the time permitted, or when you are finished, the exam paper is returned to the proctor, along with the answer sheet.

If you have questions about any of these requirements, please do not hesitate to ask the proctor prior to the commencement of the examination.

Chapter

3

Core Competencies

Core Competencies for Dialysis Technologists

Presented to the Technical Members of CANNT
CANNT Symposium, November 17th, 2000
Revisions added Dec. 4th, 2000

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Introduction

In accordance with the current Canadian Standards for Nephrology Technical Practice, (revised 2003), the following core competencies have been ratified by technical members of CANNT. These competencies include the knowledge, skills and critical judgments required by nephrology technologists to practise professionally. These represent the current expectations of the field and will be revised on a regular basis to reflect changes in the field.

The core competencies also act as a basis for the development of the examination blueprint for the certification examination. While this process is voluntary, it is hoped that that all technical members will certify themselves using the process available through the provincial engineering technology associations.

The role of the technologist in current technical practice is one that combines technical, scientific and clinical knowledge in utilizing and modifying the technology so that the long-term outcomes of the patient are optimized and complications reduced.

Critical Competencies

1. Water Treatment for Dialysis

a) need for water purification in dialysis
b) classification of potable water contaminants
c) evaluation of feed water quality
d) system components: purpose, method of operation, rationale for specific location in the system, maintenance, testing and troubleshooting for the following
    i. particle/depth filtration
    ii. carbon filtration
    iii. water softener
    iv. deionisation
    v. reverse osmosis
    vi. UV irradiation
    vii. ultra filters at point of use
e) distribution systems: importance of system configuration (direct vs indirect feed loops), piping layout to improve water velocity and decrease dead lags, selection of materials, methods of installation, calculation of velocity required
f) disinfection and cleaning: agents used, concentrations and contact times required for effective disinfection, rinsing protocols, testing for residual and reason for testing
g) water quality monitoring
    i. chemical (ph, conductivity, resistivity, total hardness, free and total chlorine, iron)
    ii. physical (% rejection and % recovery, silt density index, empty bed contact time, pressures)
    iii. microbiological (bacterial and endotoxin testing)

2. Dialysis Membrane Technology

a) principles of permeability and containment of cellular components in blood

b) membrane materials: cellulose based (modified and unmodified), synthetic materials (PS, PA, PAN, PMMA etc.)
c) manufacturing technologies: melt spinning, solution spinning
d) definition of clearance and dialysance, differences invitro and invivo
e) influencing factors: temperature, pressure, pore size, convective transport
f) dialyser designs: plate and hollow fibre
g) dialyser flow dynamics: co-current vs counter-current flow
h) requirements on housing and potting material
i) bio-compatibility of dialyser membranes, thrombogenicity, complement activation, first use syndrome, cytokine release
j) methods of sterilization and impact on thrombogenicity

3. Dialysis Membrane Re-processing

a) high level disinfection vs sterilisation methods: heat/citric acid, peracetic acid/hydrogen peroxide/acetic acid, formaldehyde, sodium hypochlorite
b) types of systems used: automated vs manual systems: applications and limitations
c) processes related to re-processing cycle: rinsing, reverse UF, cleaning, testing dialyser performance (pressure testing, fibre bundle volume, in vitro Kuf), disinfection/sterilisation, storage, testing for presence, testing for residual after rinsing, patient identification
d) CQI (continuous quality improvement) and QA (quality assurance) management: risk management strategies, statistical analysis of incidents, documentation and reporting
e) safety of public and hospital personnel: exposure to chemical agents
f) physical plant considerations: RO water supply, testing RO water for contamination, endotoxin testing, air exchange, holding tanks, physical layout of re-processing unit
g) bio-compatibility of sterilisation methods, symptoms related to bio-incompatibility
h) potential risks of re-processing

4. Basic Principles of Dialysis: Processes across membranes

a) fluid compartments in the body: intracellular, intravascular, interstitial
b) diffusion: diffusion coefficient (in free solution and across a membrane) resistance of surface layers, influence of molecular weight, membrane thickness, pore size distribution, membrane area, KoA, clearance of water soluble vs fat soluble molecules
c) filtration: pressure/filtrate flow relation, sieving coefficient and flux
d) osmosis
e) ultrafiltration: definition of ultrafiltration
f) electrical charge
g) hi-flux and lo-flux dialysers (definition, brief explanation)
h) concentration of small (urea, creatinine, urate), middle (B12, LMW heparin, heparin, insulin) and large molecules (myoglobin, albumin, hemoglobin, cytochrome C) in blood
i) absolute cut-off for molecules: 10,000 Daltons (lo- flux dialyses) and 80,000 Daltons (hi-flux dialyses)

5. Haemodialysis System Components

I. Extra-corporeal blood circuit:

a) thrombogenicity of different materials, sterilization of blood lines
b) protective filters: transducer protector
c) safety devices: air detector, clamps
d) infusion pumps (ie. heparin): calculation of infusion rates, mathematical conversion between ml/hour and IU/hour
e) blood pumps: types (occlusive, non-occlusive)
f) blood pump problems: haemolysis, pressure conditions, turbulence related to excess flow, measure of actual vs indicated blood flow
g) special applications: neonatal and paediatric

II. Concentrates for haemodialysis and haemofiltration:

a) acetate, lactate and bicarbonate buffered concentrates
b) acid concentrate
c) other electrolytes currently used
d) dry concentrates: dilution ratios
e) bacteriostatic properties
f) devices for reconstitution of concentrates & delivery systems
g) individualized dialysate prescriptions and batch systems

III. Haemodialysis Machine Hydraulic Systems:

a) **UF Control systems:** balancing chambers vs flow sensors
b) **Dialysate delivery systems design:** volumetric systems, conductometric (servo) feed-back systems
c) **Motors, pumps, valves, regulators, deaeration devices and relief valves:** purpose, location, maintenance, troubleshooting and repair
d) **Probes and sensors:** temperature, conductivity, pH, and ultrafiltration (UF), arterial and venous pressure monitoring systems - purpose, location, maintenance, troubleshooting and repair
e) **Flow equalizers, heaters, heat exchangers and end-stroke-sensors, back siphon protection:** purpose, location, maintenance, troubleshooting and repair
f) **Bypass function:** purpose, criteria for activation, calibration for safety
g) **UF measurement:** ultrafiltration rate, transmembrane pressure, ultrafiltration characteristics, impact of plasma proteins, pressure conditions along a dialyser, ultrafiltration measurement principles (closed circuit - intermittent, continuous) reverse ultrafiltration
h) **Dialysate solutions:** conductivity, temperature, precipitation risks and remedies, pH monitoring, safety mechanisms for detection of wrong concentrates
i) **Hydraulic Troubleshooting:** principles of problem identification, typical remedies, retesting, documentation of repairs
j) **Specialized Systems:** Sorbent dialysis systems
k) **Cleaning & sanitization** of hydraulic components

6. Dialysis Electrical and Electronic Systems

a) power distribution: AC, DC, 120V, 5V, 12V and 24V devices - location and rationale for each type of device in dialysis systems

b) principles of electrical safety: ground fault interruption
c) principles of operation of sensory and control devices
d) principles of electronic troubleshooting
e) proper handling of static sensitive devices: PCBs, integrated circuits etc.
f) interference by radio emitting devices, ie., cell phones
g) line isolation

7. Computer Systems in Dialysis

a) standards and software protocols
b) input devices, output devices
c) local area networks (LANs) and wide area networks (WANs)
d) dialysis specific software options: renal data management packages, treatment data base
e) criteria for purchasing decisions: type of PC, operating system, CPU, memory, use of expansion slots and COM/LPT ports
f) software implementation strategies

8. Hemodialysis On-line technologies

a) continuous blood volume monitoring , including automated UF control
b) access flow and recirculation measurements
c) blood temperature and thermal balance monitoring and control
d) ionic dialysance
e) urea concentration and dialysis dose monitoring
f) total pool dialysate collection - aliquot method

9. Safety Standards and Directives

a) overview of standards organisations and scope of their activities (CSA, AAMI, IEEC, TUN, etc.)
b) overview of government/health standards agencies (HPB/TPP) knowledge of DIN numbers, procedure for reporting patient side effects to HPB
c) electrical installation (home and in-centre) and use of electricity in patient care areas
d) water treatment for dialysis
e) dialysers and haemofilters
f) re-processing of dialysers
g) medical equipment risk classification system
h) norms and regulations on waste disposal
i) specialised guidelines for dialysis: CSN (Canadian Society of Nephrologists), DOQI (Dialysis Outcomes Quality Initiative)
j) Workplace Hazardous Materials Information System (WHMIS)
k) universal precautions
l) quality assurance of calibration equipment
m) reference individual standards

Supportive Competencies

1. Renal Anatomy/Physiology & Pathology

a) structure of the nephron - location, blood supply, nerve supply, structures
b) function of kidneys: excretion/secretion, acid-base regulation, electrolyte balance, fluid balance, blood pressure regulation, endocrine functions (Vitamin D synthesis, erythropoietin secretion, production of renal prostaglandins)
c) assessment of kidney function: biochemical and morphological tests
d) overview of commonly used medical terminology
e) overview of renal failure
    i. acute renal failure: description, causes (based on location of etiological event - pre-renal, renal and post-renal), stages (initiating, oliguric, diuretic and recovery), typical course of the disease, goals of treatment
    ii. chronic: description, causes (congenital disorders, cystic disorders, tubular disorders, neoplasms, infectious diseases, obstructions and chronic systemic diseases), stages (stage I decreased renal reserve, stage II renal insufficiency, stage III chronic renal failure), typical course of the disease, goals of treatment

2. Treatment Modalities

a) **Haemodialysis:** indications for treatment, overview of types (in-centre HD, nocturnal and home hemodialysis, self-setup dialysis centers, routine vs single needle dialysis, paediatric dialysis and complications of all treatment types
b) **Peritoneal Dialysis:** indications for treatment, function of the peritoneal membrane, access, complications related to treatment, types of treatment (CAPD, CCPD, IPD) types of cyclers, types of solutions
c) **Renal Replacement Therapies:** Haemofiltration, Haemodiafiltration, Haemoperfusion (in conjunction with other therapies): differences from HD in configuration of blood and dialysate/substitution fluid circuits, bag and on-line systems with pre and post dilution, fluid balance control systems, warming systems for substitution fluids, use of anticoagulation (monitoring activated clotting time - ACT), slow continuous ultrafiltration (SCUF), continuous arterio-venous hemofiltration (CAVH), continuous veno-venous hemofiltration (CVVH), continuous veno-venous hemodiafiltration (CVVHD) - principles of operation, indications for use, type of membrane used
d) **Renal Transplantation:** indications for transplantation, types of transplant, criteria for recipient selection, care of donor organ, complications of treatment
e) **Renal Therapeutic Nutrition:** requirements/restrictions for protein, carbohydrates, fats, fluids, vitamins, minerals (Ca, Phosphorus, Potassium etc) assessment of protein catabolic rate (PCR)

3. Assessment of Dialysis Adequacy

a) **mathematical models** of dialysis adequacy: (including but not limited to) For Haemodialysis: Dialysis Index, Urea Kinetic Modelling, standard KT/V, PRU (percentage reduction of urea) equivalent renal clearance. For Hem filtration: PCR, clearance and exchanged volume in post- and pre-dilution mode in terms of SC, KT/V, QS/QB, For PD: PET (peritoneal equilibration test)

b) **compartment models** and their use in RRT: Basics of compartment model mathematics (open and closed compartment systems), single-pool and multiple-pool kinetic models, first-order kinetics, differences for protein bound substances, regional flow models
c) **methods and devices** for measuring adequacy of dialysis: urea enzyme methods, Na substitution method for urea, aliquot method for pool dialysate collection

4. Access assessment techniques and technologies

a) **types of access:** fistula, vascular graft, catheters, other access devices
b) **evaluation of blood flow** through vascular access (Doppler techniques, blood flow dilution techniques)
c) **recirculation measurement** (concentration and dilution techniques), evaluation of pressures
d) **impact of recirculation** on dialysis efficiency (including cardiopulomary recirculation theory)

5. Anticoagulation & coagulometric technologies

a) review of coagulation cascade
b) theory of anticoagulation: indications, risks, methods of anticoagulation (systemic, extracorporeal heparinization, no heparinization - NS flushes)
c) types of anticoagulants: heparin, low molecular weight heparin, citrate, coumadin
d) interpretation of coagulation times: PT, PTT, INH, ACT (activated clotting time)
e) principles of coagulometers, including programmable meters evaluating anticoagulant kinetic

6. Complications of Haemodialysis Treatment

a) complications related to the extra corporeal circuit: air embolism, blood leak, exsanguination
b) complications related to the dialysate: haemolysis, crenation
c) complications related to the dialyser: type 1 and 2 reactions
d) complications related to the access: thrombosis, stenosis, steal syndrome, aneurysm/ pseudo-aneurysm, access re-circulation, needle infiltration, access infection
e) complications related to the patient: hyper/hypotension, cramps, nausea/vomiting, headache, chest and back pain, febrile reactions, pruritus, dialysis disequilibrium syndrome, arrhythmias, cardiac tamponade/pericarditis/arrest, hypoxemia, stroke
f) complications related to long term exposure to low level contaminants and chemicals used in dialysis treatment

7. Applied Chemistry

a) basic principles: ions and molecules, principles related to pH, molecular weight, calculations
b) application of principles of conductivity to dialysate solution: analysis of solutions pre-treatment and safety considerations

c) molecular structure and function of bio-molecules in blood: sugars, mobile fats, electrolytes, amino acids, blood proteins, hormones, enzymes and immunoglobulins
d) normal electrolyte levels, serum values of metabolic wastes in ESRD

8. Applied Microbiology

a) chain of infection
b) pathogens in the dialysis environment: common and multiply resistant organisms, characteristics of the organism
c) symptoms of infection: local and systemic
d) methods to control spread of infection by hospital personnel
e) aseptic technique
f) category specific and disease specific isolation
g) universal precautions
h) controlling contaminations to dialysis equipment & water treatment system

9. Professional Practice

a. criteria for professional practice: professional credibility, due diligence, self regulation, advanced knowledge, on-going education
b. confidentiality and consent
c. professional self regulation: responsibilities for reporting incompetence or malpractice
d. roles of professional associations: provincial/national engineering technology associations, Canadian Association of Nephrology Nurses and Technologists
e. Standards of Technical Practice for CANNT
f. Cultural Sensitivity

Chapter

4

Examination Blueprint

INTRODUCTION

In 1995, the Canadian Association of Nephrology Nurses and Technologists (CANNT) conducted a survey in which certification for technical members was identified as a priority. In a subsequent Needs Assessment, conducted in 1997, this was reiterated. CANNT has supported this process, which involves an initial certification through the Ontario Association of Certified Technicians & Technologists, followed by validation of technical competency in the dialysis technical specialty, leading to a formalized designation (yet to be determined by CANNT).

The blueprint for the Dialysis Technologist Certification Examination is a collaborative effort between CANNT and OACETT and their technical members. As the scope of technical practice evolves over time, the core competencies, blueprint and the examination will be modified in keeping with advancements in science and technology. A five-year cycle has been identified as reasonable for document review and revision in the proposal presented to the Board of Directors for CANNT.

Since OACETT will take ownership of the examination, they will ensure that these revisions will be communicated in a timely manner to the National Association office of CANNT, to board members of both associations and to technical members of the association.

EXAMINATION FOCUS

The primary function of the examination blueprint for the Dialysis Technology Certification Examination is to describe how the examination will be developed related to the Core Competencies. The blueprint also provides a guideline for item writers on how the competencies will be evaluated and at what level of the educational taxonomy the exam questions will be written, ie., Knowledge, Application and Critical Thinking.

Dialysis Technology is a specialized area of technical practice where skilled professionals support nephrology programs by providing for the preparation, operation and maintenance / repair of advanced technology required for a variety of patient care prescriptions in a variety of settings. This field of specialization has been recognized by OACETT in its legislative by-laws. In developing the Core Competencies for Dialysis Technology, the scope of practice as identified in the Technical Practice Standards (1997) was utilized. The following key points were identified.

1. The Nephrology Technologist assumes primary technical responsibility for all medical devices used in the delivery of renal replacement therapies, including but not limited to: dialysis machines, reprocessing equipment, water treatment equipment, artificial kidneys and blood lines, exclusive to unit demands.
2. The Nephrology Technologist may assume responsibilities for medical devices, not strictly related to the Nephrology program, encompassing special therapies such as: Continuous Arterio-venous Haemofiltration (CAVH) and Apheresis.
3. The Nephrology Technologist participates in the teaching of staff and individuals with renal failure.
4. The Nephrology Technologist develops and maintains Quality Assurance programs with reference to the activities listed above.
5. The Nephrology Technologist participates in administrative and research activities appropriate to their specialty.
6. The Nephrology Technologist participates as required in the clinical set up of dialysis equipment and supplies.

Additionally, a comprehensive list of technical support activities provided by the Nephrology Technologist was identified: he/she

1. provides expertise related to the management of dialysis equipment and related technology and to assist clinical staff in making informed decisions on the acquisition, use and replacement of dialysis equipment.
2. provides on-going performance assurance testing of dialysis equipment in an effective and consistent manner, thereby assuring compliance and performance to manufacturer specification and other pertinent standards.
3. performs preventive maintenance on dialysis equipment where it can be demonstrated that such activities minimize the cost, improves the quality of operation and / or reduces the downtime and disruption associated with equipment failure
4. provides quality service by establishing reasonable and measurable standards of practice for all components of technical services support.
5. periodically measures and evaluates the quality of technical services provided to Nephrology Programs and adjusts these services as necessary to maintain established standards.
6. performs daily, or as required, the activities of machine and accessory preparation, operation and disassembly to assist clinical staff with unit patient care activities.
7. provides training for the individual / family and nurses in the technical aspects of Home Dialysis or in preparation for self care in the community or hospital based unit.
8. assures that each individual has an opportunity for personal and professional development and provides a means for periodically appraising that development.
9. works in liaison with medical and nursing staff to assure on-going co-ordination of Technical Services, Renal Program and hospital objectives.
10. participates in Nephrology Program administrative activities and ensures cost effective utilization of human and material resources within budgetary control of Technical Services.
11. initiates or participates in research activities within the scope of Nephrology Technology and in co-operation with the multi-disciplinary team.

Through the certification process, the technologist will demonstrate competency with the core knowledge, values and critical judgements required for safe and professional technical practice.

The guiding documents for the examination blueprint design are the CANNT Standards for Nephrology Technical Practice, the Core Competencies for Dialysis Technologists, and content from Bloom's Taxonomy of Educational Objectives.

COMPETENCY GROUPS AND WEIGHTINGS

To ensure that the examination accurately reflects the profile of dialysis technical practice, the competencies were divided into those that are "critical" and those that are "supportive" to job performance. Part 1 consists of "critical" competencies and Part 2 consists of "supportive" competencies. Feedback from practicing technologists was solicited to create a system for establishing relative importance of each.

The critical competencies are:

1. Water Treatment for Dialysis
2. Dialysis Membrane Technology
3. Dialysis Membrane Re-processing
4. Basic Principles of Dialysis
5. Hemodialysis Systems Components
6. Dialysis Electrical and Electronic Systems
7. Computer Systems
8. Hemodialysis On-line Technologies
9. Safety Standards and Directives

The supportive competencies are:

1. Renal anatomy/physiology & pathology
2. Treatment modalities
3. Assessment of Dialysis Adequacy
4. Access Assessment Techniques and Technologies
5. Anticoagulation & Coagulometric Technologies
6. Complications of Hemodialysis Treatment
7. Applied Chemistry
8. Applied Microbiology
9. Professional Practice

Weighting of Questions

Approximately 60% of total questions will be taken from the critical competencies and approximately 40% from the supportive competencies. Depending on the level of difficulty, questions will be weighted at one, two or three points respectively for an increasing level of difficulty in the educational taxonomy.

LEVEL OF DIFFICULTY

Questions will be written at three levels of difficulty: knowledge/comprehension, application and critical thinking. These levels are adapted from the Taxonomy of Cognitive Abilities originally developed by Bloom (1956).

a) **Knowledge/Comprehension:** This level of questioning combines the ability to recall previously learned material and to understand its meaning. Typical questions relate to recalling

and understanding facts, principles and interpreting data. This type of question will be worth one point. This type of question is identified as "K" in the examination blueprint.

b) **Application:** This level of questioning requires use of existing knowledge in new situations. The outcome demonstrates use of practical problem solving. This type of question will be worth two points. This type of question is identified as "A" in the examination blueprint.

c) **Critical Thinking:** This level of questioning includes the ability to judge the relevance of information/data, to identify priorities, to formulate valid conclusions, to identify cause-effect relationships and to solve complex problems based on multiple factors. This type of questions will be worth three points. This type of question is identified as "CT" in the examination blueprint.

For the purpose of this examination, the following distribution of questions across these levels will be as follows:

Cognitive Level	**% of Questions**
Knowledge/comprehension	15 - 25%
Application	50 - 60%
Critical Thinking	20 - 30%

Chapter

5

CANNT Standards of Technical Practice

The CANNT Standards of Technical Practice represent the most current update in practice standards for dialysis technologists. The standards cover the scope of technical practice across Canada.

THE CANADIAN ASSOCIATION OF NEPHROLOGY NURSES AND TECHNOLOGISTS

STANDARDS OF TECHNICAL PRACTICE

AD HOC REVISION COMMITTEE MEMBERS:

Mukesh Gajaria Chief Technologist, Dialysis/Nephrology, Hospital for Sick Children, Toronto
Marc Heroux Technologist, The Ottawa Hospital, Civic Site

Revision #5: November 13, 2002

INTRODUCTION

Nephrology Technologists are actively involved in many aspects of the care of the individual with end stage renal disease. They have the responsibility to ensure that the equipment and methods used in nephrology-related treatments are safe, effective and in accordance with accepted protocol. The technologist shares a common goal with other nephrology professionals to provide

quality care by working effectively as part of a multi-disciplinary team. As a health care professional, the nephrology technologist has an on- going responsibility to remain current and competent in both the clinical and technical aspects of the nephrology field.

The Canadian Association of Nephrology Nurses and Technologists, (CANNT), as a professional association, has a societal mandate to establish, maintain, evaluate and revise standards of practice. Standards of practice establish measures for determining the quality of technical care the Individual with renal failure receives and provide a means for judging the competence of the Nephrology Technologist. The Nephrology Technologist requires a broad knowledge base. The CANNT Standards for Practice provide guidelines for evaluating this knowledge by identifying the minimum professional and practice expectations. The goals of the Nephrology Technologist are identified and serve as the basis for technical practice.

The CANNT Technical Standards Committee, in consultation with the Board of Directors and the CANNT membership, develops standards which address the needs of the nephrology technical community as a whole, while recognizing that diversity exists in the field.

In an effort to provide quality care, the Nephrology Technologist has a responsibility to remain current and competent in conjunction with the CANNT Standards for Nephrology Technical Practice through recognized training and continued education.

The Standards for Nephrology Technical Practice which follow are intended to:

- provide technologists with direction by identifying goals for Nephrology Technical Practice.

- Promote and define quality in Nephrology Technical Practice by outlining qualification requirements and by providing a scope of practice statement.

NEPHROLOGY TECHNOLOGY - DESCRIPTION

Nephrology technology is a specialized area of technical practice with personnel trained to provide expert support to nephrology programs in the following areas:

Hemodialysis:

Support for adult and pediatric hemodialysis programs is the largest component of the role, as hemodialysis utilizes the greatest amount of sophisticated technology.

The technologist requires knowledge in the preparation and operation of the entire clinical setup with expertise In the following areas:

- Water treatment
- Hemodialysis and water treatment equipment support
- Dialysis procedures
- Principles of dialysis
- Membrane technology
- Dialyzer reprocessing
- Computer applications
- National standards

The role of the technologist within the Hemodialysis program encompasses: preventive maintenance; troubleshooting and repair of hemodialysis equipment; clinical support; education of staff and individuals with Chronic Kidney Disease (CKD); and research in the above areas.

Peritoneal Dialysis:

Support for peritoneal programs is less intensive as the role is generally restricted to equipment support in addition to that provided to the hemodialysis program.

NEPHROLOGY TECHNOLOGY - GOAL

To support the daily operation of the unit by providing the most efficient and timely services to the patient and the multidisciplinary team.

Technical support activities:

1. To provide expertise related to the management of dialysis equipment and related technology and to assist clinical staff in making informed decisions on the acquisition, use and replacement of dialysis equipment.

2. To provide on-going performance assurance testing of dialysis equipment in an effective and consistent manner thereby assuring compliance and performance to manufacturer specifications and pertinent standards.

3. To perform preventive maintenance on dialysis equipment where It can be demonstrated that such activities minimize the cost, improve the quality of operation and/or reduce the downtime and disruption associated with equipment failure.

4. To provide quality service by establishing reasonable and measurable standards of practice for all components of technical services support.

5. To periodically measure and evaluate the quality of technical services provided to Nephrology Programs and adjust these services as necessary to maintain established standards.

6. To perform daily, or as required, the activities of machine and accessory preparation, operation and disassembly to assist clinical staff with unit patient care activities.

7. To provide training for the individual/family and nurses in the technical aspects of Home Dialysis or in preparation for Self Care in a community or hospital based unit.

8. To assure that each individual has an opportunity for personal and professional development and to provide means for periodically appraising that development.

9. To work in liaison with medical and nursing staff to assure on-going coordination of Technical Services, Renal Program and Hospital objectives.

10. To participate in Nephrology Program administrative activities and ensure cost effective utilization of human and material resources within budgetary control of Technical Services.

11. To Initiate or participate in research activities within the scope of Nephrology Technology and in cooperation with the multi-disciplinary team.

NEPHROLOGY TECHNOLOGY - SCOPE OF PRACTICE

The Nephrology Technologist may provide several levels of support depending on the size and complexity of the Nephrology program. Support is provided within a variety of settings such as hospitals, outpatient facilities and the community.

1. The Nephrology Technologist assumes primary technical responsibility for all medical devices used in the delivery of renal replacement therapies, including but not limited to: dialysis machines, reprocessing equipment, water treatment equipment, artificial kidneys and blood lines, exclusive to unit demands.

2. The Nephrology Technologist may assume responsibilities for medical devices, not strictly related to the Nephrology program, encompassing special therapies such as: Continuous Arterio-Venous Hemofiltration (CAVH) and Apheresis, PD heaters, dialysis meters, etc.

3. The Nephrology Technologist participates in the teaching of staff and individuals with renal failure.

4. The Nephrology Technologist develops and maintains Quality Assurance programs.

5. The Nephrology Technologist implements Continuous Quality Improvement techniques.

6. The Nephrology Technologist participates in administrative and research activities appropriate to their specialty.

7. The Nephrology Technologist participates as required in the clinical set up of dialysis equipment and supplies.

NEPHROLOGY TECHNOLOGY – STANDARDS OF PRACTICE

Standard I -

The Nephrology Technologist shall be competent and possess the knowledge and skills necessary to provide comprehensive support to dialysis programs by:

1. Graduating from one of the following: An approved post secondary program in Electronics, Chemistry, Biomedical Engineering or Nephrology Technology.

2. Completing an approved orientation and training program which includes such topics as:
   a) Anatomy and physiology of the renal system program
   b) Principles of dialysis
   c) Principles of water treatment
   d) Extracorporeal devices associated with hemodialysis
   e) Dialyzer reprocessing
   f) Computer applications (record keeping and statistics)
   g) Canadian Standards Association and accreditation requirements
   h) Risk Management Theory applications: documentation. chemicals handling, incident reporting
   i) Clinical dialysis procedures
   j) Teaching/learning theory
   k) Communication and interpersonal skills
   l) Introduction to ethical issues impacting on Nephrology practice
   m) Introduction to trends and issues related to research
   n) Continuous Quality Improvement (CQI)

Standard 2 -

The Nephrology Technologist respects the standards, procedures and policies relevant to the profession and practice setting and demonstrates accountability in practice by:

1. Practicing within the recognized scope of the technology

2. Functioning within the specifications of the relevant technical standards (Canadian Standards Association, Worker Safety Insurance Board, Accreditation, Workplace Hazardous Material Information Systems etc.)

3. Following established policies in reference to maintenance of records, use of medications, reporting of unusual incidents

4. Exercising professional judgement in carrying out technical support activities

5. Checking those standards, policies and procedures with the Continuous Quality Improvement Program

Standard 3 –

The Nephrology Technologist demonstrates ethical practice by:

1. Respecting the rights of the individual/family in reference to confidentiality, privacy, beliefs and values

2. Reporting unsafe practices of other health care personnel to appropriate authorities

3. Acting as an advocate on behalf of the individual/family to ensure beliefs, values and wishes are communicated and considered

4. Promoting Informed Consent by collaborating with health team members to provide unbiased information through education and support for individual/families

5. Maintaining standards of technical practice and professional behavior as determined by the practice setting, CANNT, and by national and/or provincial standards associations

6. Advocating on behalf of the Nephrology patient population to ensure delivery of safe, adequate and appropriate services, regardless of individual status

7. Promoting a safe work environment for patient and health care provider alike

Standard 4 –

The Nephrology Technologist assumes primary responsibility for acquiring and maintaining competence in Nephrology technical practice and demonstrates a commitment to on-going personal and professional growth and development by:

1. Attending continuing education programs related to trends and issues In Nephrology technology

2. Articulating an awareness of current social, political, ethical, technological and professional issues impacting on Nephrology technical practice

3. Identifying learning needs in order to maintain competence in technical practice and to achieve career goals

4. Taking appropriate action to fulfill learning needs

5. Participating in change by adapting and contributing new knowledge and skills to Nephrology technical practice

6. Promoting and creating education session to fellow technologists to help the new technologists learn from senior technologists

Standard 5 –

While functioning as a member of a multi-disciplinary health care team, the Nephrology Technologist shares unique knowledge and skills with others by:

1. Participation In and/or initiation of education programs designed for technical and other health care personnel

2. Participation in and/or initiation of rounds, conferences and seminars using appropriate channels of communication

3. Collaborating and consulting with other members of the multi-disciplinary health care team

4. Coordinating technical support with the care provided by other health care personnel.

Standard 6 –

The Nephrology Technologist provides expertise in the development of Quality Assurance programs for dialysis equipment and technical procedures in order to ensure safe and effective operation by:

1. Developing and/or implementing methods to test and verify that equipment performs within the parameters set by hospital policies, CSA and the manufacturer's specifications

2. Performing preventive maintenance and electrical Inspections on all equipment following recommendations and frequency set by manufacturers, CSA and the Hospital

3. Performing repairs according to established procedures and verifying operational safety prior to release

4. Maintaining accurate documentation

5. Participating in clinical/ technical evaluations of equipment

6. Researching and evaluating new procedures and products and reporting internally and externally if appropriate.

7. Reviewing unit policies and procedures when external standards are reviewed and upon relevant manufacturers' notification.

APPENDIX I

The Quality Assurance Program for nephrology equipment and procedures is recommended to include but not be limited to, the following tests:

HEMODIALYSIS:

1. Approved residual testing for specific chemicals used
2. Analysis of dialysate electrolytes after all calibrations
3. Microbiological testing of dialysate as per CSA Standards
4. Routine testing and calibration of hemodialysis machines as required by CSA and the manufacturer

WATER TREATMENT FOR HEMODIALYSIS:

1. Analysis of feed and treated water for organics, inorganics and micro-biological (bacteria and pyrogens) contaminants on a regular basis
2. Quality testing of the water purification system to ensure inclusion of all appropriate components and
   inert materials required for the final product water to be within CSA Standards
3. Disinfection and residual testing of water treatment systems and supply lines
4. Routine inspection for corrosion/degradation of materials
5. Consultation with manufacturers, CSA Standards, and other expert sources prior to modifying or
   redesigning existing water treatment systems in order to ensure compatibility of components and
   materials and to ensure that the system Is appropriate for the particular feed water parameters
6. Chemical analysis of Water Treatment Components in order to verify safe on-going function. (For
   example: Monitoring for carbon exhaustion as per CSA Standards).
7. Water verifications for pyrogens and other water contaminants

PEDIATRIC HEMODIALYSIS:

1. Verification of combined extracorporeat blood volume (all extracorporeal devices including blood
   lines) to ensure appropriate volume for body weight of individuals with renal failure
2. Appropriate selection and regular inspection of chair and bed scales to ensure accurate monitoring of
   individuals with low body weight, paying particular attention to the stability of extraneous items during interdialysis
   weight monitoring
3. Appropriate selection and regular inspection of fluid removal systems to ensure accuracy for individuals with low body weight
4. Appropriate selection and regular inspection of blood pumps to ensure occlusion /calibration and accuracy for various types of blood lines used In pediatric dialysis
5. It is recommended that the Nephrology Technologist providing technical support in conjunction with Pediatric clients should be aware of the special needs of infants, children and adolescents

APPENDIX II

It is recommended that the Nephrology Technologist use the following Standards available from the Canadian Standards Association:

1. C22.2 No. 125-MI984 Electromedical Equipment

2. CAN3-Z364.1.1-M84 Hemodialyzers, Hemofilters and Hemoconcentrators

3. CAN3-Z354.1.2-M84 Extracorporeal Circuits for Use With a Hemodialyzer, Hemofilter or Hemoconcentrator

4. Z364.2.1-MI986 Fluid Supply and Monitoring Systems for Hemodialysis

5. CAN3-Z364.2.2-M86 Water Treatment Equipment and Water Quality Requirements for Hemodialysis

6. CAN/CSA - 232.2-M89 Electrical Safety in Patient Care Areas

7. CAN/CSA - Z317.10-88 Special Requirements for Plumbing Installations in Health Care Facilities

Canadian Standards Association - Central
178 Rexdale Boulevard, Rexdale (Toronto), Ontario M9W IR3
Telephone (416) 747-4044 Fax (416) 747-4149

Canadian Standards Association - Eastern
865 Rue Ellingham,
Pointe-Claire (Montreal), Quebec H9R 5E8
Telephone (514) 694-8110 Fax (514) 694-5001

Chapter

6

Study Skills & Exam Success Strategies

Because the certification examination is based on both theory and practical experience in dialysis technical practice, you are already on your way to being successful. The examination covers three levels of difficulty of questioning over a number of technical competencies. As such, it is comprehensive in scope. Preparing for the examination requires adequate time and concentrated effort. Studying for the certification examination can be easier if you follow the following steps.

Optimising Study Time

Select a study area that is clean, quiet and well lit. Minimize interruptions while you study. Keep your study materials in this location, along with writing materials for note taking.

Develop a plan for approaching your study time, allowing several months for preparation. Start with the Technical Competencies in order of importance (critical competencies first, supporting competencies next). Focus on areas that are **not** your strength. Use the text materials suggested in the Reference List (next chapter) to guide your studying. Some educators use the "**5 R Method"**: **record** information in point form, **reduce** the information to key words to help recall, **recite** the key points, **reflect** on the ideas trying to see any patterns or ways of remembering the material and **review** the concepts within a few days to make them more permanent in your memory.

Study for short, intense periods rather than long exhausting marathons. You will find that your retention and retrieval of information is better. Schedule regular breaks in your study periods.

Passive learning is far less effective than a more active, involved method of studying. Focus your efforts by taking point form notes, using a highlighter while reading, cross referencing key points to the Core Competencies (CCs), and using index cards or post-its to create an active learning experience. Drawing sketches, schematics or diagrams will help you to retain information if you are a visual learner.

Studying with others is also helpful, once you have reviewed the content for the first time. The advantage of a study group is that you can clarify your questions, learn from the experience of others and stay motivated. You can also divide content to be studied, have reports or summaries prepared and study from the summaries. You can learn a great deal by posing questions to each other, working through the rationale for the chosen answer.

Exam Success Strategies

Go into the exam well rested and with a positive attitude. Remember that the examination is written to the published standards and is not intended to "trip you up", but rather to assess your knowledge in an area where you already have considerable experience.

Be in the right place at the right time for the exam and have the materials that you will need: 2 pens and 3 sharp pencils, and an eraser. Put your watch in front of you so that you can see the time and budget it carefully. You may bring in a calculator, but not a language translator or other electronic device. You will have three hours of writing time. Be sure you have your OACETT number and photo ID with you. Listen to the exam invigilator who will be making announcements about the duration of the exam. If you are uncertain about the instructions, ask for clarification before the examination begins. Should you need to take a bathroom break, one will be allowed with the permission of the exam invigilator.

Read the instructions carefully and complete the candidate information section of the paper completely. The length of the exam will be announced at the outset - it is three hours in length. Use your time carefully. Don't spend too much time on a single question that you are struggling with – move on and come back to it if time permits. Check the point value of each question (1, 2 or 3 points) and spend more time on the questions that have a higher point value.

Read each question carefully. Don't make assumptions or read into the question. Look for and highlight key words in each question. This can help you to select the correct answer from the multiple answers available. Samples of key word can include: first, most appropriate, best, always, important etc. Choose and record the best answer, using the method required by the examination. Be sure that you fill in the correct answer in the correct space. If you decide to change your answer, erase your original choice completely, being sure that there are no stray marks left on your answer sheet. Be cautious about changing answers – in many cases your first answer will be the most intuitive and may be correct. Change answers only if you are reasonably certain about the change. If you don't know the answer to the question, guess. Use the process of elimination to increase your chances of guessing well.

If you find yourself getting fatigued during the exam, or perhaps daydreaming, go back and recheck the last few questions for accuracy. Take a few deep breaths and get back in the game! Finish up when the adjudicator calls for the paper. If you are finished before the allotted time, use the time to check your paper. When you're finished the exam, don't worry unnecessarily about the outcome.

Chapter

7

Reference List

The following reference texts are available from the publishers listed below or through the Georgian College Bookstore for a nominal shipping and handling charge. Call the College (705) 728-1968 X 1570.

1. Luehmann, D. and Keshaviah, P. (1989) Manual on Water Treatment for Haemodialysis, US Department of Health and Human Services, Public Health Service, Food and Drug Administration, Rockville, Maryland

Available through NANT at Box 2307, Dayton, Ohio 45401 – 2307 or call (937) 586-3705 or email at nant@nant.meinet.com

2. Curtis, J. and Varughese, P., (Eds) (2002) Dialysis Technology: a manual for dialysis technicians, (3rd edition), Dayton, OH: National Association of Nephrology Technicians/Technologists.

Available through NANT at Box 2307, Dayton, Ohio 45401 – 2307 or call (937) 586-3705 or email at nant@nant.meinet.com

3. Daugirdas J. and Ing, T., (2001). Handbook of Dialysis (3rd edition) Philadelphia: Lippincott, Williams & Wilkins. ISBN: 0-316-17381-9

Available from the publisher at 530 Walnut Street, Philadelphia, PA., USA, 19106 or through the Georgian College Bookstore (705) 728:1968 X 1570.

4. Gutch, C.F., Stoner, M.H., and Corea, A.L. (1999) Review of Haemodialysis for Nurses and Dialysis Personnel (6th ed). St. Louis: Mosby ISBN: 0-8151-2099 –0

Available from the publisher at Mosby Publishing, 11830 Westline Industrial Drive, St. Louis, Missouri USA, 63146

5. Nissenson, Allen and Fine, Richard (2002). Dialysis Therapy (3rd ed). Philadelphia: Hanley & Belfus. ISBN: 1-56053-426-5.

Available through the publisher: Hanley and Belfus, Inc., Medical Publishers, 210 South 13th Street, Philadelphia, PA 19107 USA (215) 546-7293 or (800) 962-1892 or www.hanleyandbelfus.com.

6. Parker, Janel. (2001) ANNA Core Curriculum (4th edition). Pitman, NJ: Anthony J. Janetti

Available through the publisher. Anthony J. Jannetti, Inc., East Holly Ave, Box 56, Pitman New Jersey 08071

Chapter

8

Sample Examination

This sample test is not intended to cover every area of the Core Competencies, but rather to familiarize you with writing style and levels of questions. Consult the Core Competencies and Examination Blueprint for more direction on what to study.

After studying material covered in the Core Competencies, prepare about an hour to take the Sample Examination. Read the questions carefully and circle the correct answer. Check your answers with the Answer Key at the end of the test. For study purposes, go back to the reference materials and look up any answers that you do not answer correctly. Remember, the material tested does **NOT** assess local practices and procedures, but rather the theoretical best practices as indicated in the current reference materials. The sample exam has forty questions that cover a variety of areas. Not all Core Competencies are tested.

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1. What is the current Canadian Standards Association (CSA) standard (2003) for bacterial contamination of dialysis grade water?

   a) 50 colony forming units/ml
   b) 100 colony forming units/ml
   c) 200 colony forming units/ml
   d) 2000 colony forming units/ml

2. Which of the following are the latest contaminants to be added to the CSA standard (2003) for dialysis grade water?

I. Bromine, Iodine & Tin
II. Gallium, Boron & Molybdenum
III. Thallium, Beryllium, Antimony
IV. Endotoxin levels reduced to 2 EU/ml

   a) I and III
   b) I and IV
   c) II and III
   d) III and IV

3. For what purpose is carbon filtration used in the dialysis water treatment process?

   a) Removal of endotoxins
   b) Removal of combined chlorines
   c) Removal of contaminants such as coliforms
   d) Removal of reactive agents such as nitrates

4. Which is the most important consideration in the use of ultraviolet (UV) irradiation related to endotoxin levels?

a) Endotoxin levels may rise as a result of UV use
b) Regular maintenance is required for UV equipment
c) Bacterial destruction by UV ensures endotoxin control
d) Radiant doses of UV should be 30,000 microwatt-sec/cm^2

5. What should be done to evaluate the amount and type of depth filtration required?

a) Perform silt density index
b) Check colour of feed water
c) Measure total dissolved solids (TDS)
d) Check chlorine levels to ensure that they are below CSA Standards for dialysis grade water

6. What are the concerns regarding placement of a deionizing (DI) tank post RO?

I. Chlorine levels must be monitored
II. System will need an ultrafilter post DI
III. Endotoxin and bacteria levels may increase
IV. Water quality must be continually monitored post D1

A) II AND III
B) I, II AND III
C) I, III AND IV
D) II, III AND IV

7. What is the main function of ultrafilters at point of use?

a) To reduce ionic elements
b) To reduce water hardness
c) To reduce bacteria, viruses & endotoxins
d) To reduce pressure to the dialysis machine

8. What can disinfection of the reverse osmosis unit, distribution system and dialysis machines cause?

a) A slight increase in loop velocity
b) An immediate increase in endotoxin
c) An immediate increase in reverse osmosis permeate
d) Chemical rebound if not preceded by activated carbon

9. How much water would be added to 10 mls. of household bleach (5.25%) to make a 500 ppm chlorine solution?

a) 990 mls. of water
b) 1040 mls. of water
c) 3090 mls. of water

d) 4040 mls. of water

10. What are the effects of feed water pH on a water purification system?

I. Aluminum is not affected by pH.
II. Copper will leach out from copper pipes quicker when pH is low.
III. A low pH will reduce the ability of carbon to adsorb chlorine & chloramine.
IV. A high pH will reduce the ability of carbon to adsorb chlorine & chloramine.

a) I and III
b) I and IV
c) II and III
d) II and IV

11. The average incoming water conductance is 105 µS/cm. The product water conductance is 3.1 µS/cm. What is the % Rejection? (To two decimal places.)

a) 97.05 %
b) 97.91 %
c) 99.85 %
d) 96.95 %

12. Endotoxin results demonstrate 0.5 EU/ml. What should be done first?

a) Re-test
b) Discontinue dialysis therapy
c) Disinfect loop & flush out well
d) Inform doctor in charge of dialysis unit

13. What is the term for the tendency of a small molecular weight solute to be pulled across a semi-permeable membrane along with the solvent?

a) Diffusion
b) Osmosis
c) Convective Transport
d) Membrane Resistance

14. Which of the following would have the most impact on middle molecule clearance?

a) Pore size
b) Temperature
c) Convective Transport
d) Transmembrane Pressure

15. What is true of first use syndrome?

a) It is less likely with synthetic membranes.
b) It can be reduced by dialyzer reprocessing.
c) It can be a reaction to residual ethylene oxide in the dialyzer.
d) All of the above.

16. What is the result of constant exposure to a less biocompatible membrane?

a) It can impair the immune system and put the patient at greater risk of infection.
b) It can cause symptoms at the onset of dialysis but will have no long-term effects.
c) It stimulates the immune system allowing the patient's body to better fight infection.
d) The patient's body will adapt to the membrane over time and no long-term effects will be apparent.

17. What are the considerations for choosing an automated reprocessing system over a manual system?

a) Maximising the cost benefit.
b) Allowing for more consistent testing.
c) Reducing the opportunity for human error.
d) Allowing for computerised analysis of reprocessing results.
e) All of the above.

18. What is the purpose of the pressure holding test/leak test on a reprocessed dialyser? It:

a) Measures the internal volume.
b) Verifies the removal of all germicide.
c) Tests the structural integrity of the dialyzer.
d) Confirms the clearance properties of the dialyzer.

19. What is the sensitivity range of an air detector on a hemodialysis machine?

a) 5 to 25 µl
b) 5 to 10 µl
c) 5 to 25 ml
d) 5 to 10 ml

20. In the following scenario, which situation would result in reverse transmembrane pressure (TMP)? (All units are in mmHg; Vr = venous return pressure)

a) Vr =130 Dial pressure = -50
b) Vr =170 Dial pressure = +80
c) Vr = 80 Dial pressure = +100
d) Vr = 130 Dial pressure = +50

21. What is the purpose of having a transducer to measure the dialysate flow pressure?

a) To ensure proper dialysate flow.
b) To ensure the transfer of electrolytes to the patient.
c) To stop blood from crossing the dialyser membrane.
d) To ensure that pressure is lower on the dialysate side to reduce back filtration.

22. A hemodialysis delivery system using balancing chambers must have a(n)___ to measure the UF.

a) Good drain
b) Accurate UF pump
c) Servo feedback system
d) Burette with 0.1 ml increments

23. What must be done when a new thermistor is installed?

a) Clean the thermistor before installation.
b) Disinfect the component before calibration.
c) Recalibrate the external meter used for calibration.
d) Recalibrate the monitor due to the thermistor characteristics.

24. What parameter is <u>not</u> measured by the dialysis machine?

a) Dry Weight
b) UF Removed
c) Dialysate flow
d) Arterial Pressure

25. A dialysis machine is plugged into a circuit protected by a ground fault circuit interrupter (GFCI). Which of the following conditions will cause the GFCI to interrupt the power to the circuit?

a) The incoming voltage has risen from 115V to 135V.
b) The ground pin on the machine's electrical cord has broken off.
c) The heater has malfunctioned, causing a current of 20 mA to be conducted to ground.
d) A malfunction in the power supply has caused the current draw of the machine to increase from 10A to 16A.

26. In the RS232 standard, which pins are reversed to create a NULL modem?

a) 1 and 5
b) 2 and 7
c) 2 and 3
d) 12 and 16

27. Which intervention should be done <u>first</u> when troubleshooting an air in blood alarm?

a) Clamp the venous blood line post venous drip chamber.
b) Apply negative pressure in the venous chamber to draw back air into the venous chamber.
c) Press "Override" key and remove the clamp on the venous line below the venous drip chamber.
d) Attach recirculation connector and allow blood to recirculate until air is trapped in the venous chamber.

28. Which of the following indicates the need for measurement of access recirculation in an AV graft?

a) An increase in the serum creatinine
b) Constant arterial and venous alarms
c) Recirculation in AV grafts is rarely found
d) A decrease in Kt/v otherwise unexplained

29. What functions are performed by an automated peritoneal dialysis cycler? A cycler:

I. Counts the number of exchanges
II. Times the frequency of exchanges
III. Connects patient's catheter to solution bags
IV. Measures the volume of dialysate to be infused

a) I and II
b) III and IV
c) I, II and IV
d) All of the above

30. Which is true of slow continuous ultrafiltration (SCUF)?

a) Dialysis solution is required
b) Replacement fluid is required
c) Both dialysis solution and replacement fluid are required
d) Neither dialysis solution nor replacement fluid is required

31. Which modality minimizes protein loss in dialysate during dialysis treatment?

a) CAPD
b) CCPD
c) Hemodialysis
d) All peritoneal dialysis modalities

32. What is an advantage of a permanent central venous line when compared to a temporary central line?

a) There is less risk of thrombosis.
b) The line will never need to be changed.
c) Blood flow matches that of a well-developed fistula.
d) The tunnelling and tissue in-growth around the cuff helps to prevent infection.

33. What can cause a low venous pressure alarm?

a) A positive dialysate pressure
b) An interstitial venous fistula needle
c) A blood tubing separation at the dialyzer
d) An obstruction between the venous drip chamber and the patient

34. Heparin 1:1000 needs to be infused at 1500 IU/hr. What would be the infusion rate?

a) 0.15 ml/hr
b) 1.5 ml/hr
c) 1.5 µl/hr
d) None of the above

35. When is the peak activity of heparin reached?

a) 90 minutes following injection
b) 60 minutes following injection
c) 5 to 10 minutes following injection
d) Immediately following initial injection

36. Which symptoms would a patient manifest if he develops an air embolism while dialyzing in the supine (back-lying) position?

a) Fever, chills, nausea and vomiting
b) Double vision, confusion and dysphagia
c) Decreased pedal pulses, leg pain and pallor
d) Chest pain, shortness of breath, churning sound over the ventricles

37. Which of the following increases the conductivity of a solution?

a) Air
b) Sodium
c) Glucose
d) Pure water

38. In what situation would isolation be required?

a) Patient with HIV
b) A non-compliant patient
c) Patient with kidney transplant
d) Patient with vancomycin-resistant enterococcus

39. How can a pyrogenic reaction and an infection be distinguished?

a) By assessing the type of vascular access used
b) By assessing the patient for burning at the access site
c) By determining the duration and exact time fever symptoms began and ended
d) By reviewing previous limulus amebocyte lysate (LAL) and microbiology results

40. Close monitoring of clotting times is the best technique for administering:

a) Tight heparin
b) Liberal heparin
c) Routine heparin
d) All of the above

ANSWER KEY

Please note that every attempt is made to ensure the accuracy of the answer key with current available resources.

1. b
2. d
3. b
4. a
5. a
6. d
7. c
8. b
9. b
10. d
11. a
12. a
13. c
14. a
15. d
16. a
17. e
18. c
19. a
20. c
21. d
22. b
23. d
24. a
25. c
26. c
27. a
28. d
29. c
30. d
31. c
32. d
33. c
34. b
35. c
36. d
37. b
38. d
39. c
40. a