Appendix A: Sub-specialist training programme in Paediatric Infectious Diseases at Red Cross War Memorial Children’s Hospital and the Department of Paediatrics and Child Health, University of Cape Town

Aim

To produce competent paediatric Infectious Diseases sub-specialists with expertise in clinical infectious diseases, microbiology, virology, mycology, parasitology, infectious diseases epidemiology, infection control practice, antibiotic stewardship, outbreak investigation, immunodeficiencies that predispose to infections and ID clinical research.

Specific objectives

(1) To provide training in clinical infectious diseases for paediatricians, microbiologists and virologists
(2) To provide microbiology, virology and immunology laboratory training for clinical infectious diseases registrars through a joint training forum with the Department of Clinical Laboratory Sciences at the University of Cape Town
(3) To provide training in communicable diseases epidemiology, infection control practice and public health
(4) To develop collaborative training initiatives in paediatric infectious diseases with centres of excellence throughout Africa

The Training Unit at Red Cross War Memorial Children’s Hospital

Red Cross War Memorial Children’s Hospital (RCWMCH) is a tertiary referral hospital linked to the University of Cape Town. The Paediatric Infectious Diseases Unit (PIDU) at RCWMCH was the first paediatric ID training unit to be established in South Africa. Approval to train ID sub-specialists was granted by the Health Professions Council of South Africa (HPCSA) in February 2006. The first paediatrician commenced her sub-specialist training in the PIDU in April 2006 and successfully completed the exit examinations in March/April 2008. A parallel M Phil (paediatric infectious diseases) was established through the Faculty of Health Sciences, University of Cape Town, in January 2006. The first M Phil (paediatric ID) was awarded December 2010.

Colleges of Medicine of South Africa regulations

In accordance with regulations established by the College of Paediatricians, an affiliate of the Colleges of Medicine of South Africa (CMSA), qualified paediatricians who train in ID must complete an additional two years of training, comprising 18 months of clinical ID work and 6 months of laboratory training. A portfolio of learning template was developed by the CMSA to record progress and important milestones during the period of clinical and laboratory training. A 6-monthly review of the portfolio by the supervisor(s) and trainee is essential. Furthermore, successful completion of the CMSA ID sub-specialist examination is needed for sub-specialist certification (a requirement for all trainees), and for sub-specialist registration with the HPCSA. The training programme at RCWMCH complies with these requirements.

Clinical responsibilities

Each ID senior registrar (trainee) is expected to complete 18 months of training in clinical infectious diseases. This training will take place at RCWMCH.
Clinical responsibilities at RCWMCH include:

(1) Outpatient

Management of children with specialised infectious diseases and immunology problems who attend the Infectious Diseases Clinic on Monday mornings, together with one of the sub-specialists

Management of children with HIV-infection, particularly those on antiretroviral therapy and attend weekly HIV clinics at RCWMCH

Together with the ID sub-specialists provide ID consultation / antibiotic stewardship support to central/regional hospitals e.g. Groote Schuur and New Somerset hospitals, district hospitals e.g. Victoria and Mitchells Plain hospitals, and level 1 clinics in the Klipfontein sub-district

Together with other senior staff in the PIDU provide onsite & telephonic consultation to other paediatric antiretroviral treatment sites in the Western Cape

(2) Inpatient

Together with the ID sub-specialists, provide an ID consultation service to RCWMCH, including support for HIV-infected & HIV-TB co-infected children, sick children with tuberculosis including drug resistant tuberculosis and those with malaria, provide antimicrobial and infection control advice, and assist with the diagnosis and treatment of children with primary immunodeficiency diseases (PIDs)

Together with the ID sub-specialists conduct weekly antibiotic stewardship rounds in designated hospital wards on a rotational basis

Together with the sub-specialists conduct a problem / teaching ward round every week during which the management of patients with ID problems including issues relating to HIV infection and antiretroviral therapy are addressed.

(3) Ad hoc & telephonic consultation

Provide initial consultation on all urgent internal ID queries and external telephonic queries during working hours

(4) Infection control

Attend and contribute to meetings and activities convened by the hospital infection control committee

(5) After hours & weekends

In accordance with the practice in the Department of Paediatrics and Child Health, the ID registrar will fulfil senior registrar duties in the emergency unit of the hospital or the neonatal service affiliated to the Department of Paediatrics and Child Health. These duties provide additional experience in a wide range of ID emergencies. Weekend cover is performed in ward B1. Registrars employed through the African Paediatric Fellowship Programme are exempted from these responsibilities.
Together with the sub-specialists, the ID registrar will at times provide an after-hours Infectious Diseases consultation service to hospitals affiliated to the Department of Paediatrics and Child Health

**Educational / research objectives**

During the 2 year attachment the ID Registrar should participate in all educational activities convened by the PIDU at RCWMCH including:

1. Infectious Diseases ward rounds
2. Weekly microbiology blood culture meetings
3. HIV and immunology case review meetings
4. Infectious Diseases Journal clubs

ID registrars are encouraged to attend other ID academic meetings, symposia & courses, in particular, those hosted by the PIDU, the Institute of Infectious Diseases and Molecular Medicine (IIDMM), University of Cape Town, the Federation of Infectious Diseases Societies of Southern Africa and the Southern African HIV Clinicians Society. For example, the Federation of Infectious Diseases Societies of Southern Africa runs periodic short courses on parasitology and tropical infections for ID senior registrars who are preparing for the CMSA examinations.

In accordance with the CMSA sub-specialist training regulations, ID registrars should maintain a record of clinical cases that they have managed as well as a description of the extent of their laboratory experience in the portfolio of learning. The information on clinical cases recorded in the portfolio should include folder number, age of patient, date of entry, diagnosis, specific comments relating to the learning experience of the case, and relevant references.

Opportunities to develop presentation skills exist, for example on ward rounds, and during clinical meetings & symposia conducted by the PIDU and the Department of Paediatrics and Child Health. ID registrars should also participate in undergraduate and postgraduate teaching.

Regular feedback sessions (at least at 6-monthly intervals) should be conducted by the sub-specialists attached to the unit with each trainee.

ID registrars are expected to complete an M Phil (paediatric ID) dissertation, in publication-ready format. This gives them an opportunity to develop research and writing skills. Regular meetings between the ID registrar and the project supervisors (ID sub-specialists) will be held to direct the development and completion of the research project and minor dissertation in accordance with guidelines established by the Faculty of Health Sciences, University of Cape Town.

ID registrars are expected to complete the CMSA examination for the post-specialisation certificate in the sub-speciality Infectious Diseases [Cert ID (SA) Paed] during their 2-year ID attachment. This will permit sub-specialist registration with the HPCSA. The list of topics included at the end of this document may be used to guide preparation for this examination.
Laboratory training

Microbiology and virology training will take place in the routine NHLS microbiology and virology laboratories of the Divisions of Medical Microbiology and Virology, University of Cape Town, directed by the respective laboratory heads. Laboratory training takes place over 6 months (i.e. 4 months in routine microbiology, including 1 week in immunology, and 2 months in virology), in accordance with the HPCSA regulations. Immunology laboratory training is currently completed in the NHLS diagnostic immunology laboratory, Tygerberg Hospital. During the laboratory attachment the ID senior registrar works under the direction of the laboratory specialists, integrates into the existing laboratory schedules and participates in all laboratory activities and tasks as required. During the laboratory attachment the ID senior registrar is relieved of all clinical responsibilities to ensure full participation in laboratory activities including regular bench time, attendance of departmental meetings and journal clubs, participation in antibiotic, ID and ICU ward rounds involving the laboratory staff members, phoning out culture results, assisting with queries and general clinical liaison.

I. Goal of laboratory training

To develop a basic knowledge of the diagnostic role of the microbiology, virology and immunology laboratories in order to interface with the laboratory, collect appropriate specimens, interpret laboratory results, understand the principles and limitations of all tests.

II. Guidelines for laboratory training

During the laboratory attachment the spectrum of activities should include:

1. **Bacterial identification and susceptibility testing**
   - Perform and read a Gram stain
   - Read plates: microscopic description and identification of bacterial colonies
   - Understand principles of bacterial identification by catalase, DNAse, oxidase and sugar characteristics
   - Understand the principles of automated methods of bacterial identification
   - Antimicrobial susceptibility testing methods: prepare & interpret the E test
   - Perform the disc diffusion test
   - Understand the principles of cut-off plates
   - Understand the principles of broth dilution
   - Understand the principles of the Hodge test (carbapenamase production)
   - Understand the principles of ESBL identification
   - Understand the principles of automated sensitivity testing methods

2. **Specimen processing**
   - Understand the principles of sterile specimen collection
   - Understand the principles of automated blood culture systems
   - Process positive blood culture bottles
   - Process sputum specimens: smear preparation, Bartlett score, inoculate plates
   - Process CSF specimens: gram stain, cell counts, inoculate plates
   - Process stool specimens: wet prep, iodine stain, auramine stain, inoculate plates
   - Process urine specimens: microscopy cell count, inoculate plates
   - Process pus swabs: gram, inoculate plates
   - Process fungal cultures: inoculate plates, macroscopic description of colonies, microscopy

3. **TB specimen preparation and processing**
   - Perform Ziehl Neelsen stain and microscopy
Perform auramine stain and microscopy
Understand the principles of processing specimens for culture including decontamination
Understand the principles of processing specimens for molecular testing e.g. GeneXpert and the line probe assay
Interpret the results of TB molecular tests
Understand the principles of TB phenotypic sensitivity testing
Understand the principles of identification of non-tuberculous mycobacteria: phenotypic appearance and PCR testing

4. Understanding molecular biology methods
Understand the principles of nucleic acid extraction
Understand principles of and prepare master mixes
Understand the principles of and observe the use of thermal cyclers
Understand principles of and observe gel electrophoresis
Understand principles of and observe real-time PCR
Understand the principles of sequence analysis
Understand the principles of HIV drug resistance testing
Understand the principles of EID for HIV and HIV viral load testing
Understand the principles of molecular typing of organisms
Understand the principles of multiplex PCR

5. Serology
Syphilis serology: perform and interpret RPR and immunofluorescent assays
Understand the principles of automated ELISA; understand the indications and interpretation of results
Manual and automated serology testing
IgG and IgM assays: Use for determining immune status and diagnosing current disease.
Antigen testing using serology
Understand the principles of manual ELISA; understand the indications and interpretation of results
Limitation of IgM assays
Understand the principles of IgG avidity assays
Understand the principles of immune-chromatographic rapid tests
Understand the principles of particle agglutination rapid tests

6. Virology
The trainee should become acquainted with the pathogenesis of viral disease, basic cellular biology, basic immunology, pharmacology of antiviral medicines and the principles of good laboratory practice
Understand the principles and observe automated HIV PCR testing for early infant diagnosis.
Understand the principles and observe automated viral load testing
Understand the principles of real-time PCR
Understand the principles of virus identification / typing by neutralisation
Understand the principles of antibody detection by neutralisation
Understand the principles of virus storage and retrieval

7. Immunology laboratory
Understand the principles and observe lymphocyte subset analysis
Understand the principles of tests for total immunoglobulins and IgG subclasses
Understand the principle of the neutrophil burst test
Understand the principles of serum protein electrophoresis
Understand the principles of the total complement and individual complement component assays
8. **Laboratory safety and management**
Understand biosafety levels, safe handling of samples from a patient with suspected or proven viral haemorrhagic fever
Understand decontamination of the environment following a spill
Understand the handling of sharps, human material & hazardous waste
Understand quality assurance and laboratory accreditation

9. **Infection control and prevention**
Understand the principles of investigating an outbreak / unusual cluster of cases
Understand transmission-based precautions
Understand the principles and practice of hand hygiene
Understand the principles of disinfection and sterilisation
Pay a visit to a sterilisation unit
Visit a hospital kitchen and milk kitchen
Understand the principles of antibiotic stewardship
Understand the principles of analysing bacterial susceptibility surveillance data

**List of clinical topics**

This is not an exhaustive list but it covers important clinical topics, and may be used to guide preparation for the CMSA examination for the post-specialisation certificate in the sub-speciality Infectious Diseases [Cert ID (SA) Paed].

1. **Basic immunology concepts**
   a. Development of the immune system from fetus to adulthood
   b. Anatomical organisation of the immune system
   c. Innate and acquired (T & B cell) immunity
   d. Diagnosis and treatment of primary and secondary immunodeficiencies
   e. Investigating the child with recurrent infection
   f. Immunity to specific infections including HIV, TB, viral infections & acute bacterial infection
   g. Immunity following immunisation

2. **Congenital Infections**
   a. Congenital syphilis
   b. Viral causes of congenital infections including rubella, herpes, CMV and varicella-zoster
   c. Less common congenital infections such as toxoplasmosis and TB

3. **HIV/AIDS**
   a. The virus
   b. Pathogenesis
   c. Mother-to-child transmission and interventions to prevent MTCT
   d. Diagnosis and interpretation of laboratory assays
   e. Disease spectrum
   f. TB/HIV co-infection
   g. Management / treatment
   h. Diagnosis & management of HIV drug resistance
   i. Opportunistic co-infections
   j. Prevention, including circumcision, pre-exposure prophylaxis, post-exposure prophylaxis and vaccination

4. **Tuberculosis**
a. Pathogenesis
b. Disease spectrum
c. Epidemiology and molecular epidemiology
d. Diagnosis (specimens, microscopy, culture, PCR, immune, other)
e. Management of drug-susceptible and drug-resistant TB including INH mono-resistant TB, MDR-TB and XDR-TB
f. Prevention, including existing & newer vaccine strategies, and optimal infection control practice

5. Neonatal infections

6. Immunisation
   a. EPI and non-EPI vaccines
   b. EPI disease eradication and elimination
   c. Vaccines for neglected diseases e.g. malaria
   d. Vaccine adverse events
   e. Vaccine development: vaccine types, immunological responses, phase I to IV trials
   f. Immunisation for immunocompromised individuals e.g. children with asplenia, children with PID, children requiring / receiving long-term immunosuppressive therapy, post-haematopoietic stem cell transplantation and children requiring solid organ transplantation, and other special groups e.g. pregnant women, adolescents and preterm babies
   g. Immunisation of travellers

7. Hospital-acquired infections & infection control measures
   a. Definitions and surveillance of hospital-acquired infections
   b. Hospital infection control policy and practice
   c. Antibiotic policy and practice including antibiotic stewardship
   d. Sterilisation and disinfection
   e. Waste disposal
   f. Prevention of transmission of communicable disease in health settings (eg TB, meningococcus, varicella, measles etc)

8. Exanthems of childhood and common skin infections

9. Fever
   a. Pathogenesis of fever
   b. Inflammatory and acute-phase response
   c. Approach to fever of unknown origin
   d. Autoinflammatory disorders (defects affecting the inflammasome & non-inflammasome-related conditions) and other diseases that mimic infections in children such as malignancy and auto-immune diseases

10. Malaria
    a. Pathogenesis
    b. Spectrum of disease
    c. Diagnosis (microscopy, antigen tests etc)
    d. Management including newer therapeutic options
    e. Control and prevention, including prophylaxis regimens, environmental control and vaccines
    f. HIV/Malaria co-infection
    g. Malaria in pregnancy and neonatal period

11. Selective parasitic infections
a. Schistosomiasis
b. Trypanosomiasis
c. Cysticercosis
d. Toxoplasmosis
e. Helminthic infections
f. Hydatid disease

12. Fungal infections
a. Diagnostic approaches
b. Management of fungal infections including Candida species, Aspergillus species, Cryptococcus neoformans and Pneumocystis jiroveci

13. Gastrointestinal infections
a. Rotavirus diarrhoea
b. Cholera
c. Giardiasis
d. Amebiasis
e. Viral hepatitis including A, B, C, D and E
f. Peritonitis and other intra-abdominal infections
g. Food poisoning

14. Selective other infections
a. Viral haemorrhagic fevers (Marburg fever, Ebola viral infection, Crimean-Congo haemorrhagic fever, etc)
b. Prion diseases
c. Typhoid fever
d. Brucellosis
e. Bordetella pertussis
f. Rickettsial infection including SA tick bite fever
g. Leptospirosis
h. Herpes virus infections
i. Mycoplasma, chlamydial and ureaplasma infections
j. Measles
k. Rubella
l. Varicella
m. CMV infection
n. Diphtheria
o. Tetanus
p. Rheumatic fever
q. Cardiovascular infections
r. Infections of bones and joints
s. Meningitis and other central nervous system infections
t. Bloodstream infection
u. Urinary tract infections
v. Upper and lower respiratory tract infections
w. Skin and soft tissue infections
x. Infections related to trauma, including burns, animal bites and human bites
y. Sepsis syndrome
z. Infections of the reproductive organs
aa. Sexually transmitted infections
bb. Infections of the eye

15. Antimicrobial therapy and stewardship
a. Mechanisms of action of antibiotics
b. Mechanisms of resistance
c. Pharmacokinetic characteristics of antibiotics
d. Interpretation of MIC results
e. Managing antibiotic resistant infections
f. Antibiotics for immunocompromised children
g. Anti-TB drugs
h. Antivirals including antiretrovirals
i. Antifungals
j. Treatment of parasitic infections
k. Principles and practice of antibiotic stewardship

16. Other treatment modalities in infections
   a. Pro- and pre-biotics
   b. Immunoglobulins including monoclonal antibodies
   c. Bone marrow transplantation
d. Application of cytokines, interferons, interleukins and colony-stimulating factors in the treatment of infectious diseases
   e. Exchange transfusion
   f. Immunomodulators

17. ‘Para-infectious’ diseases
   a. Necrotising enterocolitis
   b. Reye syndrome
c. Kawasaki syndrome
d. Guillain-Barre syndrome
e. Chronic fatigue syndrome / Myalgic encephalomyelitis

18. Infections in ICU & oncology service
   a. Ventilator-associated pneumonia
   b. Infections associated with indwelling catheters & other devices

19. Infection in immunocompromised children
   a. Infections in immunocompromised patients
   b. Approach to febrile neutropenic child
c. Infections in patients with acute leukemia and lymphomas
d. Infections in haematopoietic stem cell transplant recipients
e. Infections in solid organ transplant recipients

20. Traveller medicine
   a. Preventative measures
   b. Approach to the ill traveller with suspected infection: diagnosis and treatment

21. Sexually transmitted diseases in children and adolescents

22. Current issues / emerging infectious diseases, e.g.
   a. Influenza immunisation
   b. local arboviral diseasesAvian Influenza
c. Poliomyelitis eradication
d. Zika virus infection
e. Potential bioterror agents

23. Public health principles applicable to infectious diseases
   a. Outbreak investigation
   b. Notifiable diseases
c. Tropical public health
d. Environmental control issues, including surveillance

24. Research methods & epidemiology applicable to infectious diseases
   a. Protocol development
   b. Study design
   c. Descriptive statistical concepts
   d. Inferential statistical methods
   e. Evaluation of diagnostic tests
   f. Principles of therapeutic trials
   g. Critical assessment of the medical literature including randomised control trials and systematic reviews

25. Laboratory topics
   a. Routine laboratory investigations: principles and applications
   b. Antimicrobial resistance testing: methodologies and results interpretation
   c. Advanced methodologies for detecting infectious agents

Recommended reading resources

I. Reference books

1. Mandell, Bennett & Dolin: Mandell, Douglas and Bennett’s Principles and Practice of Infectious Diseases
2. Long, Pickering and Prober: Principles and Practice of Pediatric Infectious Disease
3. Frank E. Berkowitz: Case Studies in Pediatric Infectious Diseases

II. Journals (suggested regular reading)

1. Paediatric Infectious Diseases Journal
2. Clinical Infectious Diseases
3. Lancet Infectious Diseases
4. New England Journal of Medicine
5. Lancet

References