1. Introduction

2. Curriculum domains in Paediatric Intensive Care Medicine

2.1 Resuscitation and initial management of the acutely ill child
2.2 Clinical assessment, investigation, data interpretation and monitoring
2.3 Organ system support and therapeutic interventions
2.4 Peri-operative care
2.5 Compassionate and family oriented care
2.6 End of life care
2.7 Patient safety
2.8 Transport
2.9 Acute disease management
2.10 Trauma and burns
2.11 Sepsis
2.12 Professionalism
2.13 Basic sciences

References
1. **Introduction**

This “Syllabus” describes the knowledge, skills and attitudes necessary for attaining the title “European Paediatric Intensivist” as defined by the paediatric section of the European Union of Medical Specialists (UEMS) [1,2].

In general this syllabus intends to achieve the following:

- Harmonisation of training programmes in Paediatric Intensive Care Medicine between different European countries
- Improve the level of care for critically ill and injured infants and children
- Establish clearly defined standards of knowledge and skills required to practice Paediatric Intensive Care Medicine.
- Foster the development of a European network of competent tertiary care centres for Paediatric Intensive Care Medicine
- Enhance European contribution to international scientific progress in the field of Paediatric Intensive Care Medicine

The syllabus for training in Paediatric Intensive Care Medicine (PICM) is categorised in domains, each of which is presented as knowledge, skills and attitudes in addition to basic sciences. This format inevitably results in repetition with the same topic appearing in more than one domain and linked to multiple competencies. Similarly, there is some cross-over between the knowledge and basic sciences, and knowledge and skills lists. Much of this material has been ‘graciously borrowed’ from international guidelines and national training documents, in particular from the ESICM and The Royal College, and we acknowledge with thanks the prior work done by colleagues in many countries.
2. Curriculum domains in PICM

2.1 Resuscitation and initial management of the acutely ill child

a. Knowledge

Identification of the patient at risk of critical illness including cardiopulmonary arrest
Causes of cardiorespiratory arrest
The modification of resuscitation techniques in the special circumstances of hypothermia, immersion and submersion, poisoning, electrocution, anaphylaxis, acute severe asthma and trauma
Risks to the rescuer
Indications, doses and actions of primary drugs used in the peri-arrest period
Defibrillation and principle of electrical safety
Effect of cardiac arrest on body systems
Early warning of impending critical illness
Causes, recognition and management of:
- Acute asthma
- Pneumothorax
- Hypoxaemia
- Convulsions
- Hemorrhage
- Shock
- Hypoglycemia
- Anaphylactic and anaphylactoid reactions
- Burns

Treatment algorithms for common medical emergencies
Fluid resuscitation regimens for neonates, infants and older children
Methods of securing adequate vascular access rapidly including intraosseous needle and umbilical vessel cannulation
Surface anatomy: structures in the antecubital fossa; large veins and anterior triangle of the neck; large veins of the legs and femoral triangle, axillary region, neoanatal umbilical vessel
Indications for and methods of tracheal intubation
Alternative airway techniques in the emergency setting (e.g., laryngeal mask insertion, surgical airway)
Difficult airway management algorithm
Use of rapid sequence intubation in the emergency setting
Drugs: pharmacology and dosages of hypnotics, analgesics, and relaxants
Indications for and methods of ventilatory support
Recognition and emergency treatment of life-threatening disorders of cardiac rhythm

b. Skills

Demonstrate advanced life support skills
Use a defibrillator safely
Assess conscious level, status of airway and cervical spine, and conduct careful systems review
Recognise and manage choking / obstructed airway
Airway management with mask and oral/nasal airways
Support of ventilation using bag and mask
Introduction and check correct placement of laryngeal mask airway
Oral and nasal intubation
Implement oxygen therapy and mechanical ventilation as indicated
Interpretation of capnograph trace
Age dependent techniques for external cardiac massage
Percutaneous pericardial aspiration
Obtaining vascular access sufficient to manage acute haemorrhage including intraosseous needle access
Neonatal umbilical vessel cannulation
Chest tube insertion
Fluid resuscitation and initial management of shock, including use of drugs
Use of emergency monitoring equipment
Monitor vital physiological functions
Safety checking of resuscitation equipment
Management and avoidance of cardiovascular and respiratory changes during and after intubation
Prescribe appropriate analgesia

c. Attitudes and behaviour
Safety first and knowing limitations
Always knowing the location of senior assistance
Considers legal and ethical issues: patient autonomy, appropriateness of resuscitation and PICU admission
Professional and reassuring approach – generates confidence and trust in patients and their relatives
Consult and take into consideration the views of referring clinicians
2.2 Clinical assessment, investigations and data interpretation

2.2.1 Clinical assessment

a. Knowledge
Importance of clinical history of the current condition, comorbidities and previous health status in making diagnosis
APGAR score and examination of the neonate
Sources and methods of obtaining clinical information
Clinical signs associated with critical illness, their relative importance and interpretation
Pathogenesis of multiple organ dysfunction
Principles of prevention of multiple organ dysfunction

b. Skills
Examine patients, elicit and interpret clinical signs and symptoms
Obtain relevant information from the patient, relatives and other secondary sources
Develop a working and limited differential diagnosis based on presenting clinical features
Recognise impending organ system dysfunction
Establish a management plan

c. Attitudes and behaviour
Manage patients and their families in a compassionate and considerate manner
Communicate effectively with other health care professionals to obtain accurate information and plan care
Desire to minimise patient distress

2.2.2 Investigation and data interpretation

a. Knowledge
Appropriate use of laboratory tests to confirm or refute a clinical diagnosis
Advantages and disadvantages of laboratory tests
Indications, limitations and basic interpretation of laboratory investigations of blood and other fluids (e.g. urine, CSF, pleural and ascitic fluid):

Haematology
Immunology
Cytology
Blood grouping and x-matching
Urea, creatinine, glucose, electrolytes and lactate
Liver function tests
Drug levels in blood or plasma
Tests of endocrine function (diabetes, thyroid disorders, adrenal failure)
Blood gas samples (arterial, venous and mixed venous)
Microbiological surveillance and clinical sampling

Principles, including indications, limitations and therapeutic modalities of basic radiological methods, CT scanning, MRI, ultrasound, angiography and radio nucleotide studies in the critically ill patient
Risks to patient and staff of radiological procedures and precautions to minimise risk

b. Skills
Bronchoscopic-alveolar lavage in intubated patient
Blind bronchoalveolar lavage in intubated patient
Lumbar puncture and CSF sampling
Supra-pubic aspiration of the bladder
Establish a management plan based on clinical, laboratory and radiological information
Link clinical with laboratory information to form a diagnosis
Document results of laboratory test

c. Attitudes and behaviour
Order and prioritise appropriate investigations
Communicate and collaborate effectively with all laboratory staff
Avoid unnecessary tests

2.2.3 Monitoring

a. Knowledge
Apgar score
The role of clinical assessment in monitoring
Physical principles underlying use of monitoring devices
Indications for and contraindications to the use of monitoring devices
Interpretation of information from monitoring devices, and identification of common causes of error
Principles of 'minimal monitoring'
Complications associated with monitoring and monitoring devices
Methods for measuring temperature
Methods for assessing pain and sedation, paediatric pain scores
One general method for measuring severity of illness (severity scoring systems).
Methods for severity scoring or case mix adjustment for trauma and burns
Age appropriate Glasgow Coma Scale assessment
Drug levels monitoring

b. Skills
Pulse oximetry
ECG (3- and 12-lead)
Non-invasive arterial blood pressure measurement
Invasive arterial blood pressure measurement
Central venous pressure measurement
Arterial blood gas sample handling
Inspired and expired gas monitoring for O2, CO2, and Nitric oxide
Spirometry and peak flow measurement
Ventilator alarms
Intra-abdominal pressure monitoring
Intracranial pressure monitoring
Nerve stimulator to measure therapeutic neuromuscular block
Clinical assessment of pain
Scoring or scaling systems to assess degree of sedation
Collection of data for one general method for severity scoring or case mix adjustment

c. Attitudes and behaviour
Ensure safe use of monitoring equipment in an appropriate environment
Minimise patient discomfort in relation to monitoring devices
Lead, delegate and supervise other appropriately according to experience and role
Review the need for continued monitoring regularly

2.3 Organ system support and therapeutic interventions

a. Knowledge
Thermoregulation in neonates, infants and children.
  ➢ Respiratory system
Indications for and methods of tracheal intubation.
Appropriate use of drugs to facilitate airway control.
Tube types (oral, nasal, tracheostomy etc), diameter and length.
Management of difficult intubation and failed intubation.
Methods of confirming correct placement of the endotracheal tube.
Insertion and use of oral airways, face masks and laryngeal mask airways.
Indications and contraindications to tracheostomy.
Management of and complications associated with tracheostomy tubes.
Causes of regurgitation and vomiting, prevention and management of pulmonary aspiration.
Cricoid pressure: indications and safe provision.
Airway management in special circumstances (head injury, full stomach, upper airway obstruction, shock, cervical spine injury).
Indications for and methods of mechanical ventilation.
Ventilatory modes: CMV, APRV, IRV, PRVC, SIMV, SIPPV, PTV, PS, CPAP, BiPAP, Non-invasive ventilation.
Principles of extra-corporeal membrane oxygenation (ECMO).
Detection and management of complications of mechanical ventilation.
Detection and management of pneumothorax (simple and tension).
Insertion and safe management of chest drains.
Indications and methods of bronchoscopy via an endotracheal tube.
Principles of weaning from mechanical ventilation.
Cardiovascular system
Cardiopulmonary resuscitation to PALS / APLS provider level.
Peripheral and central venous cannulation.
Arterial catheterisation.
Principles of pulmonary arterial catheterisation, oesophageal Doppler, trans-oesophageal echocardiography.
Principles of trans-venous cardiac pacing.
Use of inotropic, chronotropic, vasodilator and vasoconstrictor drugs.
Use of intravenous fluids: crystalloids, colloids, blood and blood products.
Principles of intra-aortic counterpulsation balloon pump.

Renal system
Urinary catheterisation.
Methods of preventing renal failure.
Investigation of impaired renal function.
Knowledge of nephrotoxic drugs.
Adjustment of drug doses in renal impairment / failure.
Renal replacement therapies.

Gastrointestinal system and nutrition:
Principles of adequate nutrition in the critically ill patient, including vitamins, trace elements, immunonutrition.
Assessment of nutritional status (eg: skin-fold thickness, muscle wasting).
Selection of enteral or parenteral routes for nutrition.
Nasogastric tube insertion.
Nasojejunal and principles of percutaneous feeding tube insertion.
Principles of Sengstaken tube insertion.
Principles of support for the failing liver.
Prevention of stress ulceration.
Techniques for preventing microbial translocation.
Central venous long lines for parenteral nutrition and placement of tip position.

Nervous system:
Principles of management of closed head injury.
Principles of management of raised intracranial pressure.
Indications for and use of information from intracranial pressure monitoring devices.
Principles of acute investigation and management of convulsions including status epilepticus.

Musculoskeletal system:
Prevention of pressure sores.
Principles of management of fluid losses following burns.
Short-term complications of fractures.
Consequences of muscle wasting.

Sepsis and infection:
Requirements for microbiological surveillance and clinical sampling.
Relation between laboratory results and patient's condition.
Appropriate use of antibiotics.
Proper handling of invasive medical devices.

b. Skills
Maintenance of a clear airway using bag and mask.
Oro-naso tracheal intubation.
Principle of needle crico-thyroidotomy.
Changing an orotracheal tube.
Changing a tracheostomy tube electively.
Tracheal suction.
Institution and maintenance of controlled mechanical ventilation in a critically ill patient.
Confirmation of adequate oxygenation and control of PaCO2 and pH.
Aseptic insertion of a pleural chest drain and connect to a one-way seal device.
Establish peripheral venous access sufficient to manage major haemorrhage.
Aseptic insertion of central venous and arterial catheters.
Aseptic insertion of intraosseous needles.
Aseptic insertion of a percutaneous central venous catheter for parenteral nutrition.
Appropriate use of intravenous fluids.
Appropriate use of infused vasoactive drugs.
Identification and avoidance of factors contributing to impaired renal function.
Urinary catheterisation: male and female.
Nasogastric tube placement.
Management of cardiorespiratory physiology to minimise rises in intracranial pressure
Recognition and temporary stabilisation of unstable cervical spine.

c. Attitudes and behaviour
Understand importance of ensuring physiological safety as a primary aim.
Understand difference between organ system support and specific treatment.
Appreciation of importance of timely institution of organ-system support.
Call for senior / more experienced help when experiencing difficulties.
Consideration of patient comfort in performance of practical procedures.

2.4 Peri-operative care

a. Knowledge
Factors determining perioperative risk
Indications for, and interpretation of pre-operative investigations
Dangers of emergency anaesthesia & surgery
Effect of gastric contents and dehydration on perioperative risk
Anaesthetic risk factors complicating recovery: suxamethonium apnoea, anaphylaxis, malignant hyperpyrexia, difficult airway
Criteria for admission to, and discharge from PICU
Perioperative implications of current drug therapy
Implications for postoperative care of common acute and chronic medical conditions
Indications and choice of agent for antibiotic prophylaxis
Recognition, assessment and management of acute pain
Implications of type / site of surgery for postoperative management and potential complications within the first 24 hours of surgery
Assessment and management of commonly encountered perioperative conditions & complications including:

**Respiratory**
Interpretation of symptoms and signs of respiratory insufficiency in the surgical patient; the unprotected airway; upper and lower airway obstruction including epiglottitis, laryngeal trauma & oedema; pneumonia, collapse or consolidation, pulmonary infiltrates including acute lung injury (ALI) and the acute respiratory distress syndrome (ARDS) and their causative factors; pulmonary oedema; pleural effusion, haemo/pneumothorax (simple and tension); use of chest drains; factors affecting patients following thoracotomy, lung resection, oesophagectomy, cardiac surgery and thymectomy.

**Cardiovascular**
Interpretation of symptoms and signs of cardiovascular insufficiency in the surgical patient, operative risk factors in patients with congenital heart disease, pathophysiology of congenital heart disease pre and post surgery, cardiac tamponade, heart and heart-lung transplantation.

Importance of preoperative health status on postoperative outcomes

**Metabolic and Hormonal**
Perioperative management of patients with diabetes; blood glucose control; hypoadrenalism, surgery to thyroid, adrenal and pituitary glands; inborn errors of metabolism, perioperative management of electrolyte disorders.

**Musculo-skeletal**
Principles and management of external fixators and casts; perioperative positioning; pressure area care; compartment syndromes; paralysed patients; principles of salvage surgery

**Renal**
Causes of perioperative oliguria and anuria; prevention and management of acute renal failure.

**Neurological**
Causes of post-operative confusion, coma and raised intracranial pressure, determinants of cerebral perfusion and oxygenation, prevention of secondary brain injury, perioperative management of patients with neuropathies and myopathies (e.g. thymectomy), intracranial pressure monitoring, intracerebral haemorrhage, spinal cord and brachial plexus injury.

**Gastrointestinal**
Interpretation of abdominal pain and distension; peptic ulceration and upper GI haemorrhage; diarrhoea, vomiting and ileus; peritonitis; intestinal ischaemia; perforation; abdominal hypertension; pancreatitis; jaundice; cholecystitis; management of the pre- and post-liver transplant patient; perioperative nutrition; post operative nausea & vomiting, diaphragmatic hernia, exomphalos, gastrochisis, bowel obstruction and atresias, malrotation

**Haematology and oncology**
Care of the immunosuppressed or immunoincompetent patient; complications of chemotherapy; management of severe acute haemorrhage and blood transfusion; correction of coagulation disorders and haemoglobinopathies, Jehovah’s Witness patients.

**Metabolic and Hormonal**
Perioperative management of patients with diabetes; blood glucose control; hypoadrenalism, surgery to thyroid, adrenal and pituitary glands; perioperative management of electrolyte disorders.

**Sepsis and infection**
Fever and hypothermia; postoperative hypoperfusion and impaired oxygen delivery; wound infection; opportunistic and nosocomial infection; perioperative infection risk and prophylactic antibiotics; necrotising fasciitis; peritonitis; intestinal ischaemia; antibiotic selection and prescribing
Musculo-skeletal
Principles and management of external fixators and casts; perioperative positioning; pressure area care; compartment syndromes; paralysed patients; principles of salvage surgery

b. Skills
Optimise high-risk surgical patients before surgery: consider site of care and management plan
Accurately assess the airway for potential difficulties with airway management
Consider the impact of long-term and chronic treatment on acute surgical care
Identify pre-operative health status and intercurrent disease, medications, allergies and their interaction with the nature of anaesthetic and surgery

c. Attitudes and behaviour
Establish a plan for postoperative management with other professionals
Communicate the risk of surgery to patients and family
Ensure the necessary resources are available for safe post-operative care

2.5 Compassionate and family oriented care

a. Knowledge
Causes of, and methods of minimising, distress to patients.
Bereavement: anticipating and responding to grief.
Methods of communicating with intubated patients.
Methods of measuring depth of sedation.
Stress responses.
Causes and management of acute confusional states.
Sleep deprivation and its consequences.
Physiological effects of pain and anxiety
Recognition and methods of assessment of pain
Acute pain management.
Patient and nurse controlled analgesia.
Prevention of pressure sores
Indications, contra-indications and complications of commonly used analgesic, hypnotic and neuromuscular blocking drugs.
Pharmacokinetics and dynamics of commonly used analgesic and hypnotic agents and neuromuscular blocking drugs in patients with normal and abnormal organ system function.
Indications, contra-indications, methods and complications of regional analgesia in critical illness.

b. Skills
Identify and treat causes of distress.
Propose and implement a plan to provide adequate sleep and rest in PICU
Safe use of analgesic, hypnotic and neuromuscular blocking drugs.
Management of established epidural analgesia.
Minimise complications associated with opioid and non-opioid analgesics.
c. Attitudes and behaviour
Appreciates that physical and psychological consequences of critical illness can have a significant and long lasting effect for both patients and their relatives
Desire to minimise patient distress
Establishes trusting relationships with and demonstrates compassionate care of patients and their relatives
Seeks to modify the stresses which the intensive care environment places upon patients, their relatives and members of staff
Acknowledges the consequences of the language used to impart information
Regards each patient as an individual
Respects the religious beliefs of the patient and is willing to liaise with a religious representative if requested by patient or family
Willingness to communicate with and support families / significant others
Early planning for rehabilitation
Recognises that intensive care is a continuum throughout the 'patient journey'
Promotes appropriate and timely discharge from PICU
Fosters effective communication and relationships with medical and nursing staff in other wards / departments
Recognises personal limitations, seeks and accepts assistance or supervision (knows how, when and who to ask)

2.6 End of life care

a. Knowledge
Basic ethical principles: autonomy, beneficence, non-maleficence, justice.
Role of the child and family in decision making.
Ethical and legal issues in decision-making for the incompetent patient.
Surrogate decision making.
Difference between consent and assent for treatment and research.
Methods for assessing or measuring quality of life.
Confidentiality.
Approach to end-stage organ failure.
Withholding and withdrawing treatment: omission and commission.
Difference between euthanasia and allowing death to occur: doctrine of double effect.
Procedure for withdrawing treatment and support.
Attitude of major religions to brain death and organ donation.
Cultural differences in attitudes to death and dying.
Causes of brain stem death
Legal aspects of brain stem death diagnosis
Physiological changes associated with brain stem death
Preconditions, exclusions and tests for the diagnosis of brain death.
Responsibilities and activities of transplant co-ordinators.
Management of the organ donor.
Completion of death certification.
Responsibilities of Coroner, (Procurator Fiscal or equivalent), and reasons for referral.

b. Skills
Recognise when treatment is unnecessary or futile
Discuss end of life decisions with members of the health care team
Communicating with relatives.
Discussing treatment options with patient or family before PICU admission.
Making substituted judgements and differentiating competent from incompetent statements by patients.
Obtaining consent / assent for treatment, research or autopsy.
Obtaining information on which to make assessments of quality of life.
Relieving distress in the dying patient.
Implementation of procedure for withdrawing treatment and support.
Performance of tests of brain stem function, including preconditions and exclusions.
Principle of management of the organ donor according to national / local policy

c. Attitudes and behaviour
Respect for the truth.
Respect for the expressed wishes of competent children and their families.
Liaison with religious representative (pastor, vicar, priest, chaplain, rabbi, monk, imam) if requested by patient or family.
Liaison with transplant co-ordinators.
Desire to support patient, family, and other staff members appropriately during treatment withdrawal.

2.7 Patient safety

a. Knowledge
Epidemiology, prevention, diagnosis and treatment of infection in the PICU
Environmental hazards
Principle of risk prevention
Environmental control of temperature, humidity, air changes
Hazards associated with ionising radiation
Electrical safety
Equipment requirement and selection
Common source of error and factors which contribute to critical incidents/adverse events

b. Skills
Demonstrate routine application of infection control practices to all patients
Use of protective clothing (gloves, mask, gown, drepes)
Methods to prevent autogenous infection (e.g. posture, mouth hygiene)
Implement prophylactic regimens appropriately
Document critical incident and error monitoring
Maximise safety in everyday practice
Implement safety standard for equipment
Demonstrate an interest in quality control, audit and reflective practice

c. Attitudes and behaviour
Determination to maximise safety
Share responsibility for equipment with nursing and technical staff
Recognises impaired performance in self and colleagues and takes appropriate action
Recognises personal limitations, seeks and accepts assistance or supervision
Desire to minimise patient distress

2.8 Transport

a. Knowledge
Principles of safe transfer of patients
Understanding portable monitoring systems
Determination of required number of member staffing for transport

b. Skills
Take decision to admit, discharge or transfer patients
Check transfer equipment and plan transfers with personnel prior to departure
Intra and interhospital transfer of patients requiring ventilatory support
Intra and interhospital transfer of patients with multiple organ failure

c. Attitudes and behaviour
Insistence on stabilisation before transfer
Anticipate and prevent problems during transfer
Communication with referring and receiving institutions and teams

2.9 Acute disease management

a. Knowledge
  ➢ General
Haematological and biochemical changes with age
Thermoregulation in infants
Estimation of blood volume for different ages, replacement of fluid loss
  ➢ Respiratory
Upper and lower airway obstruction including croup and epiglottitis, tachypnoea, dyspnoea, the unprotected airway; pneumonia, collapse or consolidation, asthma, bronchiolitis, pulmonary oedema, pulmonary infiltrates including acute lung injury (ALI) and the acute respiratory distress syndrome (ARDS) and their causative factors, hyaline membrane disease and chronic lung disease of prematurity, pleural effusion, pneumothorax (simple and tension), respiratory failure associated with neuromuscular disease, near-drowning, management of tracheo-oesophageal fistula and tracheomalacia, diaphragmatic hernia, cystic fibrosis, foreign bodies
  ➢ Cardiovascular
Hypotension and hypertension, shock (cardiogenic, hypovolaemic, septic), left and right ventricular failure, cardiomyopathies, pulmonary hypertension, cor pulmonale, pulmonary embolus, malignant hypertension, cardiac tamponade, atrial tachycardias, ventricular tachycardias, conduction disturbances, atrial and ventricular fibrillation, pacing box failure, the presentation of congenital cardiac disease, the management of ductus arteriosus dependent lesions, recognition of pulmonary oligaemia and plethora, recognition of total anomalous pulmonary venous drainage, myocardial ischaemia related to anomalous coronary artery insertion

- Renal and genito-urinary

Oliguria and anuria, polyuria; urological sepsis, acute renal failure, chronic renal failure.; renal manifestations of systemic disease including vasculitides, nephrotoxic drugs and monitoring, renal transplantation

- Gastrointestinal

Abdominal pain and distension, peptic ulceration and upper GI haemorrhage, diarrhoea and vomiting, GIT failure; pancreatitis, jaundice, fulminant hepatic failure, paracetamol (acetaminophen)-induced liver injury, the presentation of congenital surgical conditions, gastrchisis, exomphalos, bowel atresias, malrotation, intestinal obstruction, meconium ileus, tracheo-oesophageal hernia, diaphragmatic hernia

- Neurological

Confusion and coma, post-anoxic brain damage including trauma and near drowning, Intracranial haemorrhage and infarction, intraventricular haemorrhage associated with prematurity, convulsions and status epilepticus, meningitis and encephalitis, medical causes of raised intracranial pressure, neuro-myopathies (e.g. Guillain-Barre, myasthenia gravis, malignant hyperpyrexia) causing respiratory difficulty, critical illness polyneuropathy, motor neuropathy, and myopathy, neurological syndromes, infection / occlusion of ventriculoperitoneal shunts, neurodevelopmental milestones, assessment of brain death

- Sepsis and infection

Pyrexia and hypothermia, patients at risk, immunodeficient syndromes, organ-specific signs of infection including haematogenous (venous catheter-related, endocarditis, meningococcal disease), urological, pulmonary, abdominal (peritonitis, diarrhoea), skeletal (septic arthritis) and neurological. Organisms causing specific infections: Gram positive and Gram negative bacteria, fungi, protozoa, viruses (e.g. influenza, RSV, Hepatitis A, B and C, HIV, CMV), use of antibiotics. Prevention of nosocomial infection

- Haematology and oncology

The immunosuppressed or immunoincompetent patient, oncological issues, agranulocytosis and bone marrow transplant patients, severe anaemia, major blood transfusion, coagulation disorders, haemoglobinopathies

- Metabolic, hormonal and toxicology

Fluid and electrolyte therapy, electrolyte disorders, acid-base disorders, diabetes, hyper- and hypo- thyroidism, adrenal and pituitary gland disorders, the acute presentation of inborn errors of metabolism, general principles of the treatment of poisoning

- The Skin

Dermatological disorders; the skin as an organ, burn management

- Genetics

Syndrome associations and chromosome anomalies

b. Skills

Develop a limited differential diagnosis based on presenting clinical features
Develop a differential diagnosis to include less common or rare conditions
Recognise that diverse diseases share limited forms of acute physiological expression
Identify and integrate co-morbid diseases with the acute condition

c. Attitudes and behaviour

Acquire, interpret, synthesize, record, and communicate (written and verbal) clinical information
Develop a working, and limited differential diagnosis based on presenting clinical features
Recognise and diagnose commonly encountered acute medical conditions
Recognise impending organ system dysfunction
2.10 Trauma and burns

a. Knowledge

Performance and interpretation of a primary and secondary survey

Environmental hazards & injuries: hypo- and hyperthermia, near-drowning, electrocution, radiations, chemical injuries, electrical safety/micro shock

Effects and acute complications of severe trauma on organs and organ systems:
- Respiratory - thoracic trauma; acute lung injury; tension pneumothorax
- Cardiovascular - hypovolaemic shock; cardiac tamponade
- Renal - acute renal failure; rhabdomyolysis
- Neurological - altered consciousness; traumatic brain injury; post-anoxic brain injury; coup and contra-coup injuries; intracranial haemorrhage and infarction; spinal cord injury
- Gastrointestinal - abdominal trauma; abdominal tamponade; rupture of liver or spleen
- Musculoskeletal system - soft tissue injury; short term complications of fractures; fat embolism; crush injury & compartment syndromes; maxillofacial injuries

Emergency airway management

Anatomy and technique of crico-thyrotomy

Methods for securing vascular access

Causes, recognition and management of shock states

Techniques for effective fluid resuscitation

Principles of blood and blood component therapy; principles of massive transfusion

Indications for and methods of ventilatory support

Triage and management of competing priorities

Management of cervical spine injuries

Methods for assessing neurological function e.g. Glasgow Coma Scale

Principles of management of closed head injury; coup and contra-coup injuries; methods of preventing 'secondary insult' to the brain; recognition and immediate management of raised intracranial pressure

Principles, including indications, limitations and therapeutic modalities of basic radiological methods, CT scanning, MRI, ultrasound, angiography and radionucleotide studies in the critically ill patient

Indications for and basic interpretation of chest radiographs: range of normal features on a chest x-ray; collapse, consolidation, infiltrates (including ALI/ARDS), pneumothorax, pleural effusion, pericardial effusion, position of cannulae, tubes or foreign bodies, airway compression, cardiac silhouette, mediastinal masses

Principles of outcome prediction / prognostic indicators and treatment intensity scales; limitations of scoring systems in predicting individual patient outcome

Management of the shaken infant

Compartment syndrome

Calculation of area burned

Prevention of infection in the burned child

Smoke inhalation and carbon dioxide poisoning

Fluid resuscitation in the burned patient, in relation to burned area
b. Skills
Assessment and immediate stabilisation of the trauma patient: primary and secondary survey. Calculation and documentation of Glasgow coma scale. Recognition of need for appropriate investigations (Hb, cross-match, chest X-ray, CT scan etc). Recognise signs and symptoms of impending cardiac arrest 
Obtain vascular access sufficient to manage acute haemorrhage, rapid fluid infusion and monitor cardiovascular variables 
Implement emergency airway management, oxygen therapy and ventilation as indicated 
Assess conscious level, status of airway and cervical spine, and conduct careful systems review 
Prioritise the order of investigations and interventions for individual injuries according to their threat to life 
Protect a potentially unstable cervical spine 
Assess, predict and manage circulatory shock 
Monitor vital physiological functions as indicated 
Demonstrate emergency relief of tension pneumothorax 
Analgesia for the trauma and burned patient. 
Describe the endpoints of burn resuscitation and preferred fluids 
Identify or describe risk factors for airway compromise in the burned patient 
Determine when the patient's needs exceed local resources or specialist expertise (requirement for transfer) 
Professional and reassuring approach - generates confidence and trust in patients and their relatives

c. Attitudes and behaviour
Rapid response and resuscitation 
Focus on the ‘golden hour’ 
Appreciates the importance of timely institution of organ-system support 
Clear in explanations to patient, relatives and staff 
Ability to take control when either appropriate or necessary 
Insist on stabilisation before transfer 
Communication with the patient and relatives

2.11 Sepsis

a. Knowledge
Pathogenesis, definitions and diagnostic criteria of sepsis, severe sepsis, septic shock and systemic inflammatory response syndrome (SIRS) 
Causes, recognition and management of sepsis-induced organ dysfunction; multi-system effects of sepsis and their impact on clinical management 
Universal precautions and good working practices (hand washing, gloves etc) 
Proper handling of medical devices including intravascular devices 
Cross infection: modes of transfer and common agents
Autogenous infection: routes and methods of prevention
Emergence of resistant strains
Antibiotic policies in a hospital
Activity of commonly used antibiotics
Common surgical infections: antibiotic choice and prophylaxis
Infections from contaminated blood
Hepatitis and HIV infections: modes of infection: natural history: at risk groups
Immunisation policy
Sterilisation of equipment
Strategy if contaminated

b. Skills
Implement emergency airway management, oxygen therapy and ventilation as indicated
Resuscitate a patient with septic shock using appropriate monitoring, fluid therapy and vasoactive agents
Manage antimicrobial drug therapy
Obtain and interpret results of microbiological tests
Recognition of at risk groups including the immunocompromised patient
Develop a working, and limited differential diagnosis based on presenting clinical features
Order and prioritise appropriate investigations
Establish a management plan based on clinical and laboratory information
Critically appraise the evidence for and against specific therapeutic interventions or treatments
Consider potential interactions when prescribing drugs & therapies
Define targets of therapy and review efficacy at regular intervals
Consider modifying diagnosis and/or therapy if goals are not achieved
Prevent, identify and manage hyper / hypoglycaemia
Lead, delegate and supervise others appropriately according to experience and role
Recognise and manage emergencies; seek assistance appropriately
Application of methods for preventing autogenous infection (e.g.: posture, mouth hygiene).

c. Attitudes and behaviour
Every patient is entitled to the best care available
Prevention of self-infection
Prevention of cross infection

2.12 Professionalism

a. Knowledge
Published standards of care at local, regional and national level
Requirements for training
Local policies and procedures
Methods of audit and translating findings into sustained change in practice
Recent advances in medical research relevant to paediatric intensive care
Consent and assent in the competent and non-competent patient
Confidentiality and data protection - legal and ethical issues
Methods of effective communication of information (written; verbal etc)
Principles of crisis management, conflict resolution, negotiation and debriefing
Principles of delivering bad news to patients and families
Strategies to communicate to the general population critical care issues and their impact on the
maintenance and improvement of health care
Basic ethical principles: autonomy, beneficence, non-maleficence, justice
Ethical and legal issues in decision-making for the incompetent patient
Sources of information about different cultural and religious attitudes and beliefs to life threatening
illness and death available to health care professionals
Impact of occupational and environmental exposures, socio-economic factors, and life style factors on
critical illness
Principles of professional appraisal and constructive feedback
Principles of adult education and factors that promote learning
Purpose and process of quality improvement activities such as evidence based practice, best practice
guidelines & benchmarking and change management
Methods of audit and translating findings into sustained change in practice
Use of information technology to optimize patient care and life-long learning
Electronic methods of accessing medical literature
Identification and critical appraisal of literature; integration of findings into local clinical practice
Principles of appraisal of evidence: levels of evidence; interventions; diagnostic tests; prognosis;
integrative literature (meta-analyses, practice guidelines, decision & economic analyses)
Principles of applied research and epidemiology necessary to evaluate new guidelines / forms of
therapy
Principles of medical research: research questions; protocol design; power analysis, data collection,
data analysis and interpretation of results; manuscript preparation and publication rules
Ethical principles involved in conducting research (including subject protection, consent,
confidentiality and competing interests) and national ethical approval processes
Ethical management of relationships with industry

b. Skills

Communication
Communicate with patients and relatives - give accurate information and re-iterate to ensure
comprehension; clarify ambiguities
Discuss treatment options with a patient or relatives before PICU admission
Involve patients in decisions about their care and treatment
Differentiate competent from incompetent statements by patients
Communicate effectively with relatives who may be anxious, angry, confused, or litigious
Obtain consent/assent for treatment, research, autopsy or organ donation
Use non-verbal communication appropriately
Use available opportunities and resources to assist in the development of personal communication
skills
Communicate effectively with professional colleagues to obtain accurate information and plan care
Manage inter-personal conflicts which arise between different sectors of the organisation,
professionals, patients or relatives
Acquire, interpret, synthesize, record, and communicate (written and verbal) clinical information
Listen effectively
Professional and reassuring approach - generates confidence and trust in patients and their relatives

- **Professional relationship**
  Act appropriately as a member or leader of the team (according to skills & experience)
  Lead, delegate and supervise others appropriately according to experience and role
  Communicate effectively with professional colleagues to obtain accurate information and plan care
  Collaborate with other team members to achieve common goals
  Consult and take into account the views of referring clinicians; promote their participation in decision making where appropriate
  Liaise with medical and nursing staff in other departments to ensure optimal communication and continuing care after ICU discharge
  Acquire, interpret, synthesize, record, and communicate (written and verbal) clinical information
  Manage inter-personal conflicts which arise between different sectors of the organisation, professionals, patients or relatives
  Participate appropriately in educational activities and teaching medical and non-medical members of the health care team
  Contribute to professional meetings - understand their rules, structure and etiquette
  Listen effectively
  Respect, acknowledge & encourage the work of others

- **Self directed learning**
  Attentive to detail, punctual, reliable, polite and helpful
  Take decisions at a level commensurate with experience; accept the consequences of these decisions
  Lead, delegate and supervise others appropriately according to experience and role
  Collaborate with other team members to achieve common goals
  Contribute to departmental / PICU activities
  Participate in the processes of clinical audit, peer review and continuing medical education
  Propose realistic initiatives / projects to promote improvement
  Utilise personal resources effectively to balance patient care, learning needs, and outside activities.
  Develop, implement and monitor a personal continuing education plan including maintenance of a professional portfolio
  Use learning aids and resources to undertake self directed learning
  Use electronic retrieval tools (e.g. PubMed) to access information from the medical & scientific literature
  Use a systematic approach to locate, appraise, and assimilate evidence from scientific studies relevant to a patient's health problem
  Participate appropriately in educational activities and teaching medical and non-medical members of the health care team
  Demonstrate initiative in problem solving
  Listen effectively

**c. Attitudes and behaviour**
Integrity, honesty & respect for the truth underpin relationships with patients, relatives and colleagues
Caring and compassionate with patients and relatives.
Functioning within competence.
Accepts appropriate advice from other healthcare professionals.
Supportive of colleagues.
Demonstrates initiative in analysing problems and critically evaluates current practice.
Professional and reassuring approach

2.13 Basic sciences

a. Knowledge

2.13.1 Evidence Based Medicine
Levels of evidence
- Meta-analysis
- Systematic reviews.

Stages in the design of a clinical trial.

Principal concepts in statistics:
- Distribution of data and frequency distributions
- Measures of central tendency and dispersion of data
- Non-parametric and parametric tests in statistical inference
- Tests that examine relationships (eg correlation, regression).

Principles of errors of statistical inference (eg. Type I & II) and techniques to minimise such errors.
Sources of bias and confounding in medical research and methods to reduce such bias.

Concepts of sensitivity, specificity, positive and negative predictive value and how these are affected by the prevalence of the disease in question.
Statistical methods used to estimate risk.
Concept of significance and testing of significance.

2.13.2 Growth and development

Overview and assessment of variability:
- Biopsychosocial models of development

Fetal growth and development (gestational age assessment).
The newborn:
- Determinants of parenting
- The infant’s contribution
- Clinical implications: the physician’s role.

The development during the first and second year.
Preschool years:
- Physical development
- Language, cognition and play
- Emotional development.

Middle childhood:
- Physical development
- Cognitive and language development
- Social and emotional development.

Adolescence:
- Early adolescence
- Middle adolescence
- Late adolescence.

Assessment of growth:
• Growth chart derivation and interpretation
• Analysis of growth patterns
• Other indices of growth.

Developmental assessment:
• Screening and surveillance
• Diagnostic assessment.

2.13.3 Physiology

To understand physiology and its application to clinical practice, including relevant applied anatomy.

➢ Respiratory system

Developmental anatomy of airways and lungs:
• Laws of lung development
• Embryology of the lungs
• Transition to air breathing
• Postnatal lung growth.

Developmental mechanics of breathing:
• Pressure-flow relationship in the respiratory system
• Surface tension and elastic recoil
• Airway resistance
• Lung volumes.

Pulmonary gas exchange:
• The blood-oxygen equilibrium curve
• Carbon dioxide in blood
• Alveolar ventilation and alveolar PO2
• Diffusion
• Limitations of pulmonary gas exchange
• Ventilation-perfusion mismatching
• Carbon dioxide exchange
• Cardiovascular and tissue oxygen transport.

Physiologic effects of mechanical ventilation:
• Maintenance of oxygenation
• Maintenance of alveolar ventilation
• Mechanics of ventilation
• Work of breathing.

Developmental anatomy and physiology of the pulmonary circulation:
• Pulmonary vascular pressure
• Pulmonary vascular resistance
• Fetal and perinatal pulmonary circulation
• Distribution of pulmonary blood flow
• Hypoxic pulmonary vasoconstriction
• Bronchial circulation
• Lung fluid balance.

Regulation of breathing:
• General concepts
• Developmental aspects.
Normal respiratory parameters.

➢ **Cardiovascular system**
Developmental cardiac anatomy and physiology:
• A primer on cardiac embryology
• Developmental changes in the structure of the heart
• Autonomic innervation of the heart
• Transition from fetus to neonate.
Hemodynamic principles:
• Flow, velocity, and cross-sectional area
• Pressure, flow, and resistance
• Compliance.
Interaction of the cardiac pump and the vasculature:
• Vascular function curve
• Cardiac function curve
• Interaction of vascular and cardiac function curves
• Regulation of vascular resistance
• Regulation of regional circulations.
Cardiopulmonary interactions:
• The cardiopulmonary circulation
• The effect of changes in intrathoracic pressure on heart function.

➢ **Renal system**
Developmental anatomy of the kidneys:
• The renal vasculature
• The nephron unit.
Developmental physiology of the kidneys:
• Renal blood flow
• Glomerular function
• Tubular function
• Endocrine role of the kidney.
Pathophysiology of body fluids and acid-base:
• Composition of body fluids
• Regulation of osmolality and volume
• Electrolytes
• Acid-base balance.

➢ **Digestive system**
Development and developmental anomalies of the teeth.
Embryology, anatomy and function of the esophagus.
Gastric and intestinal structure, digestion, absorption of nutrients, water and electrolites:
• Digestion of carbohydrates
• Digestion of proteins
• Digestion of lipids
• Intestinal lymphatics
• Regulation of electrolytes and water movement
• Gastrointestinal neuroendocrine control
• Electrolyte transport.

The pancreas:
• Pancreatic exocrine secretory function

The hepatobiliary system:
• Anatomy
• Hepatic function
• Enterohepatic circulation.

Host-defense mechanism of the gut: immunology and microbiology.
Gastrointestinal and hepatobiliary testing in PICU.

➢ Haematological system
Development of the hematopoietic system:
• Erythropoiesis
• Granulocytopoiesis
• Megakaryocyte and platelet production
• Hemoglobin.

Structure and function of the bone marrow.
Structure and function of the secondary lymphoreticular system:
• Spleen
• Lymph nodes.

Hemostasis:
• Hemostatic mechanism
• The clinical and laboratory evaluation
• Developmental hemostasis.

➢ Nervous system
Developmental anatomy and physiology of the nervous system:
• brain development timeline
• neurogenesis and proliferation
• migration, differentiation, and axonal guidance
• synaptogenesis, gliogenesis, and myelination.

The basic electrophysiology of neural tissue:
• Resting membrane potential
• Conduction of nervous impulses
• Action potentials
• Excitatory and inhibitory post-synaptic potentials
• Synaptic function

The major sensory and motor pathways.
The physiology of cerebrospinal fluid.
The autonomic nervous system and its role in controlling body function.
The major neurotransmitters and their physiological role.
The physiology of the control of intra-cranial pressure.
The physiology of sleep.
The basis of the electroencephalogram, evoked potentials and nerve conduction studies.

- **Musculoskeletal system**
  Developmental anatomy and physiology of skeletal, smooth and cardiac muscle.
  Physiology of the neuromuscular junction.
  Mechanism of excitation-contraction coupling.
  Concept of motor units.
  Relationship between muscle length and tension.

- **Endocrine system**
  Hormones of the hypothalamus and pituitary gland:
  - Anterior lobe hormones
  - Hormones of the neurohypophysis.
  Thyroid development and physiology:
  - Fetal development
  - Thyroid physiology
  - Thyroid regulation
  - Thyroid hormone studies.
  Hormones and peptides of calcium homeostasis and bone metabolism:
  - Parathyroid hormone
  - Parathyroid hormone-related peptide
  - Vitamin D
  - Calcitonin.
  The physiology of the adrenal gland:
  - Histology and embryology
  - Adrenal steroid biosynthesis
  - Regulation of the adrenal cortex
  - Adrenal steroid hormone actions
  - Adrenal medulla.
  Development and function of the gonads:
  - Embryonic gonadal differentiation
  - Function of the testes
  - Function of the ovaries
  - Diagnostic and therapeutics aids.

- **Immunologic system**
  The innate immune system:
  - Pathogen recognition, signaling and pathogen killing
  - Localization of infection by coagulation
  - Modulators of innate immune inflammation
  - Clinical manifestations of the innate immune response.
  Comparison of the innate and the adaptive immune responses.
Soluble components of immunity:
- C-reactive protein
- Complement system
- Immunoglobulin
- Contact activation system
- Lipid-derived mediators of inflammation
- Cytokines

Cellular components of immunity.
Balance between proinflammation and anti-inflammation.

- **Nutrition and metabolism**
  Basic principles of energy expenditure and metabolism:
  - Respiratory quotient
  Key nutrients and nutritional requirements:
  - Macronutrients
  - Glucose
  - Fats
  - Proteins
  - Micronutrients
  - Trace elements and minerals.

  **Immunonutrition**:
  - Glutamine
  - Arginine
  - Nucleotides
  - Omega-3 polyunsaturated fatty acids
  - Branched-chain amino acids.

- **Thermoregulation**:
  Physiology of thermoregulation:
  - Heat gain
  - Heat loss.

- **Pain**:
  Developmental neurobiology and physiology of pain:
  - pain pathways and mediators involved in nociception, conduction, spinal cord modulation and central processing of pain
  - peripheral and central sensitization
  - gate control theory
  - prehemptive and preventive analgesia.

  Pain assessment:
  - Self-reported measures
  - Observational-behavioral measures
  - Special considerations for the assessment of the cognitively impaired.

  Strategies for pain management:
  - Pharmacological treatment
2.13.4 Pharmacokinetics and pharmacology of drugs in children

Pharmacokinetics:
- Absorption
- Bioavailability
- Distribution
- Metabolism
- Phase I and phase II biotransformation
- Elimination.

Organ dysfunction:
- Renal dysfunction
- Hepatic dysfunction
- Cardiac dysfunction.

Physiologic differences in children that affect drug disposition:
- Renal
- Hepatic
- Gastrointestinal
- Body composition.

Approach to pharmacodynamics and pharmacogenomics.

Central nervous system effects.

The drug approval process, the package insert and drug labeling.

References