

**Section 1**  
**INTRODUCTION TO PAEDIATRIC**  
**INTENSIVE CARE NURSING**

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# Chapter 1

## INTRODUCTION TO CHILDREN'S INTENSIVE CARE

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### **Introduction and background**

It is widely accepted that paediatric intensive care (PIC) is a service for children and young people with potentially recoverable diseases, who can benefit from more detailed observation and treatment than is generally available in the ward environment (DH 1997). While this describes the nature of the care on the unit, the paediatric intensive care unit (PICU) is much more complex, and many elements contribute to the intensive care environment. Children's nurses and their medical colleagues are experienced and educated to a high standard in very specific and advanced care practices. The physical environment is dominated by advanced technology, which plays an ever-increasing role in monitoring, treating and supporting children and young people who are critically unwell. However, the core of the ethos of care in the PICU are the children, young people and their families, for whom this experience will be one of the most stressful events of their lives.

The criticality of the situation for many of the children and young people admitted to the PICU is immense, however the most recent audit of PIC services in the United Kingdom (UK) demonstrates that the large majority (>95%) survive beyond their admission to the PICU (PICANet 2010). In the period 2006–8 there were 47 125 PIC admissions to 28 NHS hospitals in the UK, with chil-

dren under 1 year of age comprising 47% of all admissions, and an overall excess of boys (56%) over girls (44%). The majority of admissions (57%) were unplanned and 78% of children who are retrieved are done so by specialist PIC teams (PICANet 2009). It is clear that PIC makes a large contribution to the care of children and young people in the UK, offering specialist skills, care and knowledge, alongside ever-advancing treatment.

### **The organisation of PICU care**

PICUs, like paediatric high dependency units, historically have been organised in an ad hoc manner. They were often located in specialist children's hospitals or supported specialist services, such as cardiology and neurosurgery. During the early 1980s the Paediatric Intensive Care Society and the British Paediatric Association started to raise concerns about the patchy organisation and lack of standards for children and young people requiring intensive care.

In 1993 a multidisciplinary working party published a report, based on a retrospective survey of 12 882 children identified as having received intensive care in 1991, which highlighted issues facing the provision of paediatric intensive care (British Paediatric Association 1993). Their findings indicated that 29% of children were cared for in

children's wards, 20% in adult intensive care units and only 51% in PICUs. Of the 2 627 children cared for in adult units, 23% were <1 year and almost 5% were <1 month old. In adult units fewer than 2% of nurses had a children's nursing qualification. Only 36% of PICUs provided a transport service for retrieving critically ill children. The working party expressed particular concern about facilities where medical and nursing staff had not received specific training and where the staffing levels were too low for managing critically ill children, for example in children's wards.

While the findings were shocking when compared to the high standard of care and organisation associated with the modern PICU service, the report was largely ignored until the death of a young person (NG) in 1995. NG died in a PICU as the result of a cerebral haemorrhage. Before reaching the unit he had been moved from the admitting hospital to another hospital for computed tomography (CT) scanning and only then to an intensive care unit (in another region) for management. After the publication of the resulting inquiry (Ashworth 1996), the Secretary of State commissioned a report on the development of paediatric intensive care services and the Department of Health (DH) set up a national coordinating group to develop a policy framework.

The evidence gathered and documentation recognised that the national PIC service was disorganised, having developed over a 20-year period in a makeshift manner. They recognised that the service was a low-volume but high-cost provision and identified that there were no national standards or evidence base. Ten of the 29 PICUs identified had three beds or fewer, placing in question their ability to offer services to the most critically ill children. *Paediatric Intensive Care: A Framework for the Future* (DH 1997) set out a strategy for developing and integrating the service for critically ill children within a geographical area. During the following three years lead centres for PICU care were identified, and within each region one, or at most two, lead centres were designated, to serve a population of at least 500 000 children. Lead centres had to be based in hospitals with a full range of tertiary paediatric services, run a 24-hour transport service for the region and have sufficient throughput to maintain staff expertise and act as educational and training centres. Lead centres were also responsible for the provision of retrieval training to referring hospitals and compiling audit and quality data for their regional service.

While this hub-and-spoke arrangement generally worked well, some areas (e.g. the London region, the Midlands and Scotland) had more than one large PICU within a geo-

graphical locality. The introduction in 2001 of Managed Clinical Networks (MCNs – partnerships of healthcare professionals and organisations involved in the commissioning, planning and provision of a health service in a specific geographical area) has furthered the development of paediatric intensive care services, offering more opportunities for joint working and service coordination, especially where duplicated services existed. MCNs were recommended for neonatal intensive care services in 2003 following a service review (DH 2003) and the National Service Framework for Children and Maternity Services (DH and DfES 2004) recommends MCNs for all children and young people's services. Their aim is to provide quality of care by dismantling the barriers between primary, secondary, tertiary and social care. They require multidisciplinary management and ensure that all staff working with a particular patient adhere to the same protocols and policies (DH and DfES 2005). For paediatric intensive care services in particular, MCNs enable the development of core training, treatment pathways and standards. They include referring hospitals, local lead PICUs, Accident and Emergency Departments as members, with the aim of ensuring high quality and safe paediatric intensive care services. The largest MCN for PICU services is the Pan Thames Consortium, which includes nine core hospitals and two retrieval services (see [www.picupt.nhs.uk](http://www.picupt.nhs.uk) for further information).

### **Differentiating paediatric intensive care**

Paediatric intensive care can be distinguished from other forms of care by the severity of illness the child or young person is experiencing, the standard level of care being that available on a ward, with high dependency care being an intermediate level, followed by intensive care. Within intensive care it is important to recognise the level of dependency a child or young person presents with, as this will have an impact on the nurse staffing levels required to ensure safe and appropriate care. The DH (1997) report identified one level of high dependency care, two main levels of intensive care, while alluding to a fourth level, which includes treatment with Extra Corporeal Membrane Oxygenation (ECMO). The Paediatric Intensive Care Society (2010) has developed the criteria further (Table 1.1).

### **Commissioning auditing and costing**

The DH utilises a non-clinical system to assess levels of care and dependency for audit and costing purposes. Health care Resource Groups (HRGs) have been used to cost care since 2007, based on seven levels:

**Table 1.1** Differentiating paediatric intensive care

Level/recommended staffing ratio	Descriptor
Level 1 High dependency care requiring a nurse-to-patient ratio of 0.5:1	Close monitoring and observation required, but not acute mechanical ventilation. Examples include the recently extubated child who is stable and awaiting transfer to a general ward; the child undergoing close postoperative observation with ECG and pulse oximetry, receiving intravenous fluids or parenteral nutrition. Children requiring long-term chronic ventilation with tracheostomy are included in this category.
Level 2 Intensive care requiring a nurse-to-patient ratio of 1:1	The child requires continuous nursing supervision and is usually intubated and ventilated (including CPAP). Also included is the unstable, non-intubated child, for example, some cases with acute upper airway obstruction who may be receiving nebulised adrenaline. The recently extubated child. The dependency of a Level 1 patient increases to Level 2 if the child is nursed in a cubicle.
Level 3 Intensive care requiring a nurse-to-patient ratio of 1.5:1	The child requires intensive supervision at all times and needs additional complex therapeutic procedures and nursing, for example, unstable ventilated children on vasoactive drugs and inotropic support or with multiple organ failure. The dependency of a Level 2 patient increases to Level 3 if the child is nursed in a cubicle.
Level 4 Intensive care requiring a nurse-to-patient ratio of 2:1	Children requiring the most intensive interventions such as particularly unstable patients, Level 3 patients managed in a cubicle, those on ECMO or other extracorporeal support and children undergoing renal replacement therapy.

- HRG1 – High Dependency (HD1)
- HRG2 – High Dependency Advanced (HD2)
- HRG3 – Intensive Care Basic (IC1)
- HRG4 – Intensive Care Basic Enhanced (IC2)
- HRG5 – Intensive Care Advanced (IC3)
- HRG6 – Intensive Care Advanced Enhanced (IC4)
- HRG7 – Intensive Care – ECMO/ECLS (IC5)

While this further division of dependency may be more sensitive, it is widely regarded as too cumbersome and complex for clinical use and takes no account of the individual and holistic care needs for the child's parents or carers and siblings.

### Standards for staffing and skill mix

A fundamental issue in the commissioning and management of paediatric intensive care services is the number of nurses required to ensure safe, high quality care, bearing in mind the unpredictable dependency of patients and rate of bed occupancy. Murphy and Morris (2008) performed

an audit of 10 PICUs and found that 83% of costs were staff-related, with the largest being nursing. Workforce planning is also affected by the number of beds, the layout of the unit and the number of single rooms. The recent introduction of Agenda for Change has also increased the whole-time equivalent (WTE) from the traditional benchmark of 6.4 WTE per bed to 6.7 WTE on an average unit due to the increased annual leave entitlement for experienced nurses (Paediatric Intensive Care Society 2010).

Commissioners of paediatric intensive care services have had to take into consideration the seasonal fluctuation many units experience and the effect this has on bed capacity. Many commissioners plan nursing staff levels based on an average bed capacity of 80%, however this can be problematic at times of peak capacity when it may be necessary to ask staff who are already working to their full capacity to undertake extra shifts or employ bank and agency staff, which can both impact on quality of care and be costly. Some units have used annualised hours for part-time staff, enabling them to undertake more planned shifts in busy periods and more leave in the summer.

In addition to annual leave, workforce planning needs to take into consideration additional burdens on staffing. Associated with the levels of patient dependency in paediatric intensive care are minimum recommended nurse-to-patient ratios, Level 2 being 1:1; Level 3 1.5:1 and Level 4 2:1. Furthermore, the need for a nurse in charge who has no direct responsibility for a particular patient, the need for a runner, staffing of retrieval teams, calculations for sickness (thought to be 5% of a WTE) and study leave for mandatory training need to be considered. The calculation of 6.7 WTE per bed the Paediatric Intensive Care Society recommend PICUs work towards does not include factors that can increase the WTE considerably, for example maternity leave which is difficult to anticipate and has to be incorporated into workforce planning on a case-by-case basis, as does study leave to undertake specialist paediatric intensive care courses and the level of supervision and induction new staff require and for how long. Table 1.2 summarises the Paediatric Intensive Care Society's calculations.

A worked example – A PICU with 15 beds with nurses working a two-shift/day roster (each nurse working 3–4 days a week). The mean dependency on the unit is a 1.0 nurse per patient per shift ratio and the average occupancy is 80%. The unit uses nurse runners, that is nurses with no allocated patient who check drugs and infusions, help set up equipment, assist with more dependent patients and cover meal-breaks.

The unit requires 4.65 WTE bedside nurses per bed for 80% occupancy. When one includes the runners and the

nurse in charge (who should not be providing bedside care or meal-break cover) this rises to 5.38 WTE per bed. Commissioners must decide whether they want to staff to capacity (6.7 WTE/bed) to allow for peak demand (Paediatric Intensive Care Society 2010).

Consideration of the skill mix alongside minimum staffing levels is essential. However, it is difficult to match skill mix on a shift-by-shift basis, when the severity of illness of patients presenting may vary enormously. Current standards for nursing skill mix from the Paediatric Intensive Care Society recommend 'that all PICUs should have a senior and experienced practitioner to coordinate and supervise less experienced nurses to ensure high quality care over the 24-hour period with a Registered Children's Nurse at Band 7 or above and that all units should be managed overall by a Senior Nurse/Matron, Band 8a or above' (Paediatric Intensive Care Society 2010, p. 44).

The most recent report of the UK PICU Staffing Survey (Tucker et al. 2009) indicates that the PICU workforce is highly qualified and highly skilled: 93% of nurses hold a children's nursing registration, a third are senior nurses at Grade F or higher (pre-Agenda for Change) and identified in the skill mix for some units were advanced practitioners and nurse consultants. However, the survey did find that staffing, education and skill mix were increasingly problematic areas for some units, specifically in managing long-term sickness, difficulties in recruitment and retention, cuts in training budgets and increased pressure on beds. Furthermore, the reduction in junior doctors' hours

**Table 1.2** Summary of the Paediatric Intensive Care Society's calculations

Row	Category	Formula	Column B
1	Mean dependency		1.0
2	Number of nursing shifts per day		2
3	Number of days worked per nurse per week		3.12
4	Allowance for sickness/annual leave/training	26% Deficit – Factor = 1.26	1.26
5	Number of beds in unit		15
6	Number of beds per runner		8
7	Number of WTE bedside nurses/bed	$B1 \times B2 \times (7/B3) \times B4$	5.65
8	Total number of nurses (includes 1 in charge per shift and runners)	$(B7 \times B5) + B7 + ((B5/B6) \times B7)$	101
9	Total number of bedside nurses	$B7 \times B5$	85
10	WTE of bedside nurses per bed at capacity	$B9/B5$	5.7
11	Overall number WTE per bed at capacity (includes one in charge per shift and runners)	$B8/B5$	6.7

resulting from the European Working Time Directive seems to have had an impact, and the survey identified the substitution of junior medical staff with advanced nursing posts in some units.

### Developing roles in PICU

The current developments in nursing roles are underpinned by the policy document *Modernising Nursing Careers* (DH 2006) and the subsequent *Towards a Framework for Post-Registration Nursing Careers: Consultation response report* (DH 2008). The 2010 government review of nursing may also influence the development of specialist roles as well as guiding the profession as a whole. Currently, there are three levels of practitioner in paediatric intensive care: Specialist Practitioner, Advanced Practitioner and Nurse Consultant. The recent reviews of nursing career frameworks emphasised the need to move away from traditional careers pathways which removed aspiring practitioners from clinical care, to education and management posts. The roles of Advanced Practitioner and Nurse Consultant are designed to enable nurses to remain in clinical practice while developing skills in areas such as advanced clinical skills, leadership, education and research. The roles of Advanced Nurse Practitioners are currently developed at a local level and there are few common roles or standards. Llewellyn and Day (2008) found that a survey of staff attitudes to advanced practice revealed multiple interpretations of the role. The Nursing and Midwifery Council (NMC) have for some time been discussing the Advanced Practitioner role, but have failed to incorporate it into the current system of professional regulation by recording educational achievement to this standard on the register.

The UK PICU Staffing Survey (Srivastava et al. 2008; Tucker et al. 2009) found that many advanced tasks are undertaken in PICUs: taking blood samples, processing blood samples, altering oxygen levels; adjusting ventilator settings, chest assessment, broncho-alveolar lavage, setting up CPAP (continuous positive airway pressure), initiation of non-invasive ventilation, planned nurse-led extubation, end-of-life extubation, intubation, venepuncture, arterial cannulation, titration of analgesia, weaning of analgesia, titration of inotropes, setting up CFAM (cerebral function analysis monitor); advanced life support skills, nurse-led retrieval and haemodialysis.

Of 27 eligible PICANet units, 26 completed the survey. Of these, only four reported having a designated advanced post of Nurse Consultant or Advanced Nurse Practitioner. Further analysis of these tasks identified that some advanced skills (e.g. blood sampling and processing, setting up CPAP drivers, titration and weaning off analgesia) were routinely

reported as undertaken by specified grades of trained nurses in nearly all units. Clearly, the role of Advanced Nurse Practitioner cannot be defined purely by the tasks undertaken; the role also includes professional autonomy and accountability for one's caseload, diagnostic skills and the authority to initiate investigations/referrals, clinical and professional leadership (McGee 2009). According to the Department of Health (2006), Advanced Practitioners can provide 'high productivity and value for money'. Thus far the role of Advanced Nurse Practitioner in PICU remains relatively new (unlike in neonatal nursing where the role has flourished). Advanced nursing practice is complex, concerned with the development of nursing with greater inter-professional collaboration, not necessarily with the amalgamation of nursing into medical roles (Heward 2009).

Nurse Consultants within paediatric intensive care services are few. Even though the role was introduced in 1999, it was not utilised widely until the last four years. The role is centred on improving the quality of patient care. McGee (2009) identifies the main facets of the role as: working at least half their time in clinical practice; being experts in the field; working directly with patients and acting as focal points for professional advice; undertaking research activities; and being involved in education of staff across the multidisciplinary team. Nurse Consultants currently found within paediatric intensive care services also contribute at a national level, influencing policy decisions within the Department of Health, the Royal College of Nursing and the Paediatric Intensive Care Forum. Nurse Consultants are often affiliated to a local university department (either a nursing or medical school).

The role nurses fulfil within paediatric intensive care services at all levels is vital to the care of children and young people, and their families, in order to provide high quality care. The contribution of children's nurses to the development of paediatric intensive care services is significant and their role is expanding to include counselling, family liaison (e.g. in Birmingham Children's Hospital) and post-PICU inter-hospital transfer (Solomon and Clarke 2009).

### Education in PICU

The education of nurses within paediatric intensive care is currently provided by in-house education programmes or BA/BSc, MA/MSc and PhD programmes. The links between Benner's levels of clinical practice (Benner 1984), current role alignment and educational attainment are outlined in Table 1.3.

All PICUs have an induction and training programme for new nursing staff to ensure that all nurses achieve



**Table 1.3** From novice to expert

Benner's level	Role	Professional/educational level
Novice	Staff nurse new to PICU	Registered plus Diploma/Degree undertaking preceptorship period
Advanced beginner	Staff Nurse	Registered plus diploma/degree completed in-house education programmes
Competent	Specialist Practitioner	Degree specialist practice
Proficient	Advanced Practitioner	MA
Expert	Nurse Consultant	PhD

Source: modified from Benner 1984.

a basic level of intensive care competence and can offer safe and effective care to the majority of ventilated children and young people on the unit. These courses are usually facilitated by the PICU lead nurse for training and development, and in some units are linked to the local university's Specialist Practitioner PICU course. Standards for in-service programmes have been developed by the PICS-E (2002), although there is little evidence to indicate widespread adoption of these. Education within PICU is essential to ensure regular updating and the achievement of mandatory and statutory training.

A number of issues can influence the ability to deliver effective training and development opportunities within PICU.

- Unpredictable dependency of patients, leading to an inability to release staff for in-service training.
- Formalising training and development activities through the development of reflective journals and competency-based documents are time-consuming.
- Limited training equipment and teaching space.
- Limited funding for external courses and the need to prioritise Specialist Practitioner courses and Paediatric Advanced Life Support Courses.

The role of the training and development lead within PICU is essential and multifaceted. It includes:

- Developing and facilitating in-service induction, orientation and competency-based programmes to ensure the competence of all nurses in intensive nursing care.
- Monitoring and facilitating opportunities for mandatory and statutory training on the unit.
- Leading the educational component of new clinical developments and inter-professional learning opportunities.
- Developing and documenting the unit's training needs analysis in conjunction with the unit's matron.
- Liaising with university education providers in relation to mentorship of pre-registration nursing students, mentorship of students on Specialist Practice programmes and procedures for nurses wishing to access higher education courses.
- Supporting the education component of capability programmes associated with fitness-to-practice issues in conjunction with the unit's matron.

#### ***Higher education and professional body partnerships***

Specialist Practitioner programmes for paediatric intensive care nurses are undertaken in universities and are usually delivered at degree level. The NMC monitors these courses as they can currently lead to a recordable qualification on the register. However, the Paediatric Intensive Care Society Education Group has identified some concerns and has called for validation of a national paediatric intensive care course. Their concerns are:

- The number of 'taught' hours in these programmes is being reduced by higher education institutions. This is justified by the HE institutions as the programmes are expensive to run for a small number of students.
- The pressure of time on the clinical staff makes it increasingly difficult to allow them time off to attend programmes and learn.

The lack of basic knowledge in clinical sciences, and anatomy and physiology on the part of holders of nursing diplomas or degrees makes revision of these topics essential to equip them to function effectively in an intensive care environment. This reduces the amount of time that can be spent delivering PIC content even further. The regulations of HE place restrictions on the educators when working within academic institutions, for example, the assessment times may be set or there may be limits on the course leader's ability or authority to change and modify the programme's assessment processes. There are general difficulties in marrying the academic and service demands of these programmes – for example, should clinical assess-



ment be graded or not? If yes, there are issues of parity across the assessment opportunity afforded to students and of parity among assessors.

There are recommendations for a national course at degree level of 6–9 months with three main aims:

- At the end of the course the student should be a competent PICU nurse and be able to manage without support a Level 2 intensive care patient and Level 3 or 4 ICU patients with senior supervision and support.
- Graduates will be able to deliver evidence-based care to the child and family and be able to communicate effectively with the patient, family and health care team.
- Graduates will understand the organisational and political context of paediatric critical care.

(Paediatric Intensive Care Society Education Group 2010).

While the aim of these recommendations is useful in guiding the development of paediatric intensive care courses, the NMC is reluctant to include specific content in addition to the existing generic Specialist Practitioner outcomes, which will limit the implementation of any national guidance.

### *New ways of learning in PICU*

In recent years the technological ability to simulate the sick baby and child has developed tremendously, and the traditional 'resuscianne' used for teaching basic life support has been superseded by a number of high-fidelity patient manikins. These include one neonatal simulator (SimNewB<sup>®</sup>, Laerdal Medical), two infant simulators (SimBaby<sup>®</sup>, Laerdal Medical; and BabySim<sup>®</sup>, METI: Medical Education Technologies) and one child simulator (PediaSim<sup>®</sup>, METI: Medical Education Technologies). These simulators are capable of simulating advanced airway procedures, lung, heart and bowel sounds, vital signs and advanced monitoring, palpable pulses and pneumothorax procedures and are constantly developing. They are used in complex, scenario-based education which includes, but is not exclusive to, resuscitation. A number of PICUs have purchased these simulators, the average cost of which is £25 000, and they are utilised in pre-retrieval training at referring hospitals (Cardiff and Nottingham are examples), and in multi-environment simulations such as Accident and Emergency/Children's Ward to PICU (for example Bristol Children's Hospital and St. Mary's in London.)

Simulations using high-fidelity simulators are ideal for developing the clinical decision-making and team working skills of the multi-professional team, who include those

working as paramedics, in children's wards, Emergency Departments and PICU staff. Gabba (2004) suggests that simulation enhances patient safety by focusing on the education of teams rather than of individuals, offering a structured approach and the ability regularly and systematically to mirror reality. While there is some evidence of simulation being integrated into university programmes (Clarke and Davies 2009), much of the discussion continues to take place in the United States. In the United Kingdom it is recognised that while simulation is beneficial, planning, enacting and debriefing can be labour-intensive (Summers and Kingsland 2009); however, the benefits in relation to patient safety in high-risk areas, such as intensive care, outweigh the effort required.

### **Conclusion**

Paediatric intensive care is a highly complex environment and is dependent on adequate and planned staffing, clear patient assessment and educational programmes based on competency and the attainment of clinical skills. Within the last 10 years there have been significant advances in the development of paediatric intensive care standards and services, supported by an increasing number of roles which are breaking down traditional boundaries. This chapter has outlined the fundamental elements of ensuring that paediatric intensive care services and nurses are fit for purpose and ready to deliver high standards of care.

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