PAEDIATRICS

A NATIONAL MODEL OF CARE FOR PAEDIATRIC HEALTHCARE SERVICES IN IRELAND

CHAPTER 40: PAEDIATRIC PHARMACY

Feidhmeannacht na Seirbhíse Sláinte
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Clinical Strategy and Programmes Division

ROYAL COLLEGE OF PHYSICIANS OF IRELAND

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40.0 INTRODUCTION

The pharmacy departments at Our Lady's Children's Hospital Crumlin (Crumlin) and Temple Street Children's University Hospital (Temple Street) are the national reference points for health care professionals, children and carers involved in all aspects of paediatric medicines management, and play a vital and unique role in minimising the risk of medication error. As the transfer of paediatric patients between primary, secondary and tertiary care is a recognised source of medication error, paediatric pharmacy services occupy a pivotal role in the current and proposed paediatric model of care.

The knowledge required to deliver dispensary, drug information, clinical and aseptic compounding services by pharmacists and technicians is highly specialised, and requires a pharmacy service exclusively dedicated to paediatrics. This exists in major international paediatric centres of excellence, including the United States, United Kingdom and Australia. This approach is also recognised and recommended by leading international accreditation and patient safety agencies including Joint Commission International, the Institute of Safe Medication Practices and the American Society of Health System Pharmacists.

Errors involving medications are considered to be the most common type of medical error and are a significant cause of preventable adverse events. In 2012, the State Claims Agency's report on adverse events ranked medication errors as the third most common type of adverse event after falls and patient aggression. Medication errors were reported more frequently than adverse events caused by other aspects of patient treatement (Ogelsby, 2013). Paediatric patients, particularly those in critical care, are known to be at increased risk from medication error (AAP Steering Committee on Quality Improvement, 2011, Ghaleb et al., 2010, Kaushal, 2001). Numerous interventions have been proposed to improve medication safety, including ward-based clinical pharmacists and the increased use of technology including computerised physician order entry (CPOE) (AAP Steering Committee on Quality Improvement, 2011, Council on Clinical Information Technology Executive Committee, 2013, Rinke et al., 2014, Conroy et al., 2007, Fernandez and Gillis-Ring, 2003, Manias et al., 2014, Kaushal, 2002). The use of standardised concentration infusions (SCIs) and smart pump technology has also been widely recommended to help reduce infusion errors (Institute for Safe Medication Practices, 2009, National Patient Safety Agency, 2007, Larsen et al., 2005, Iacovides et al., 2014, Irwin et al., 2008, Hilmas et al., 2010) but these require careful implementation and regular review to ensure the benefits are achieved (Husch et al., 2005, Adachi and Lodolce, 2005, Manrique-Rodriguez et al., 2012, Manrique-Rodriguez et al., 2014).

40.1 CURRENT SERVICE PROVISION

The current paediatric pharmacy service is mainly centralised in the three Dublin children's hospitals and larger regional centres (Cork, Galway and Limerick). Services are ward- and team-based, and are described below in more detail.

Dispensary and Ward-based Services

Dispensary services are an integral part of medicines management in any health system, and are responsible for the following:

- Cost effective procurement and purchasing of medicines from approved suppliers for use in paediatric patients.
- Maintenance of appropriate records of medication transactions, including restricted antibiotics, blood derived medications and vaccines.
- Ordering home antibiotics for various patient cohorts transferring to primary care.
- Assessment of both licensed medications and exempt medicinal products (EMPs) for use in paediatric patients. This assessment is shared with regional and local hospitals, and primary care on request.
- Checking (for accuracy and appropriateness) and dispensing of prescriptions to inpatients and outpatients to ensure seamless medicines management transition to primary care.
- Dispensing of medicines to all inpatient clinical areas and wards.
- Dispensing of clinical trial medicines, and maintenance of records by clinical trial pharmacist involved in local/national non-oncology clinical trials.
- Manufacture of extemporaneous preparations where no commercial products are available. This involves sourcing or developing suitable formulations which are then referenced nationally. These are obtained from pharmacy departments in other international children's hospitals or from literature. Extemporaneous sheets are developed and used as guidance for preparing preparations. Technicians skilled in manufacturing prepare the final product to standards set out by the Pharmaceutical Society of Ireland (PSI).
- Dispensing of specialised discharge prescriptions for EMPs, formerly known as unlicensed medicines, or medicines that are difficult to obtain in the community.
- Liaising with primary care with regard to medicines patients are discharged on, with special reference to EMPs and extemporaneous medicines.
- Developing standard operating procedures for the running of the pharmacy in line with best practice.
- Providing a pharmacist-led pharmacy service to Rainbow Clinic (national paediatric infectious diseases clinic) in Crumlin. This involves attending weekly multidisciplinary meetings, dispensing antiretroviral medication and counselling patients/carers with regard to the medicines. Practice is informed and delivered in line with the PENTA guidelines (Paediatric European Network for Treatment of AIDS), the CHIVA guidelines (Children's HIV Association), and the EACS Guidelines (European AIDS Clinical Society).
- Providing a senior technician-led pharmacy service to specialised clinics, e.g. sickle cell disease clinic. This involves attending weekly multidisciplinary meetings, dispensing hydroxycarbamide and counselling patients/carers with regard to medicines. Regional hospitals are also supported and information shared as patient care is transferred to local areas. Practice is informed and delivered in line with Crumlin Sickle Cell Guidelines and international best practice. Health areas local to the patient are invoiced monthly for hydroxycarbamide liquid or hydroxycarbamide (Siklos®) tablets.
- Answering medicine information queries and maintaining appropriate activity records for the service. Queries are internal from health care professionals and external from primary, secondary and tertiary care centres.
- Creation and maintenance of standard operating procedures relating to all pharmacy activities.

Antimicrobial Stewardship

Antimicrobial resistance is increasing and has become a major global public health problem. The control and prevention of antimicrobial resistance, the reduction of medication-related adverse events, and the reduction of unnecessary financial costs, through having an effective antimicrobial stewardship programme, is a strategic goal for all acute hospitals. In 2009, the Health Service Executive (HSE) Strategy for the Control of Antimicrobial Resistance in Ireland working group published Guidelines for Antimicrobial Stewardship in Irish Hospitals (SARI, 2009). The recommendations included in these guidelines are evidence-based, reflect international best practice and detail antimicrobial stewardship interventions that have been shown to be successful. These guidelines were also used as the basis for Standard 12 of the National Standards for the Prevention and Control of Healthcare Associated Infections, produced by the Health Information and Quality Authority in 2009 (HIQA, 2009). All hospitals are required to implement antimicrobial stewardship programmes, in order to comply with this standard. Many units have a dedicated antimicrobial pharmacist (currently one WTE in Crumlin and 0.45 WTE in Temple Street).

The paediatric antimicrobial pharmacist oversees and co-ordinates the delivery of antimicrobial stewardship strategies by the clinical ward pharmacy and is a key member of antimicrobial stewardship team along with the Infectious Diseases team and clinical microbiologist. They perform clinical review of patients receiving antimicrobials, and are a source of advice and information for prescribers, other clinical pharmacists and healthcare professionals. They ensure antimicrobial therapy is optimised to the individual patient including, where necessary, therapeutic drug monitoring. They can advise on streamlining or de-escalation of therapy to avoid unnecessary use of antimicrobials. The antibiotic pharmacist plays a key role in the development of antimicrobial guidelines for the hospital, e.g. empiric guidelines for the treatment of infection, guidelines for surgical prophylaxis, and guidelines detailing clinical criteria and information for converting parenteral antimicrobial therapy to oral therapy. The antibiotic pharmacist is responsible for periodic updates and maintenance on the guidelines in electronic format on the hospital intranet and Smartphone application.

Clinical Pharmacy

A paediatric clinical pharmacy service includes, but is not limited to, reviewing the prescribing of medicines, reviewing the administration of medicines and where appropriate giving guidance regarding same, medicines reconciliation and documentation of drug therapy, reviewing drug use, communicating with the multidisciplinary team (MDT) and other healthcare professionals with regard to drug therapy, patient counselling and education, recording of medication errors, making interventions to prevent medication errors and education of staff on same. Drug charts (electronic and hard copy), intravenous infusion sheets and blood product sheets are reviewed regularly in order to fulfil these requirements.

Ward / clinical pharmacists have an important role in the education of nursing and medical staff contributing to study day education programmes and staff induction programmes.

In Crumlin, pharmacists provide a clinical pharmacy service to the following wards:

- Burns Unit
- Children's Heart Centre (Cardiology)
- Emergency Department
- ICU
- Haematology / Onclogy
- Orthopaedics

- Cystic Fibrosis and General Medicine, General Surgery
- Medical infants up to 2 years
- Surgical infants up to 2 years
- Transitional Care Unit (TCU) and long stay complex patient cohort
- Urology
- Nephrology

A paediatric clinical pharmacy service is also provided to St. Raphaels ward in Beaumont Hospital, Dublin. A senior pharmacist reviews the pharmaceutical care of a diverse group of children, including patients requiring:

- ENT procedures (grommets, adenoidectomy, tonsillectomy, etc.)
- Cochlear Implants (National Paediatric Cochlear Implant Programme)
- Neurosurgical investigations and treatments (National Referral Centre for Neurosurgery)
- Transition from paediatric to adult services for specialist treatment (cystic fibrosis, neurology, nephrology)
- General medical and general surgical treatment from ED for adolescents (16 – 17 yrs).

Cystic Fibrosis

Cystic fibrosis (CF) is Ireland's most common life-threatening inherited disease, with one in 19 people carrying the gene (CFAI, 2012). Ireland has the highest incidence in Europe with 1:1353, and a prevalence of 2.98 per 10,000 (Farrell PM, 2008). Crumlin is the national paediatric centre for CF treatment. CF is a chronic illness with a high drug burden and patients require major pharmaceutical care which is complex and costly. The benefits of a dedicated CF pharmacist have been well-documented (Redfern J, Webb AK. 2004).

The minimum recommendation for a specialist paediatric CF pharmacist is 0.3WTE for every 50 patients, i.e. one full time specialist post for a cohort >150 patients (Pollock, 2005). As a member of the MDT, the impact of a paediatric pharmacist can contribute significantly to detecting prescribing errors and improving patient safety. The primary roles of the CF pharmacist are to detect medication errors, make a clinical intervention to highlight drug-related concerns and recommend a change to the medication order where appropriate. This role also includes ordering home intravenous medications, answering drug-related queries from the MDT, and dose recommendations for inpatients and outpatients. The CF pharmacist attends biweekly annual review clinics with outpatients. At this clinic, the pharmacist performs a review of all current medicines, discusses changes to any recent treatments, enquires about compliance, side-effects, allergy status, use of over the counter medicines, supply from community pharmacy and any other concerns relating to the patient's medicines.

Cardiology

Paediatric cardiology services are provided in Crumlin with a dedicated 27 bedded 'Children's Heart Centre' (CHC) inpatient ward, cardiac intensive care unit (ICU), cardiac catheterisation lab. This medical service is provided for all children on the Island of Ireland who require cardiothoracic surgery, with a focus on correction of congenital defects. A report by the US Poison Control Centre found that cardiovascular drugs when compared to many other drugs lead to higher fatality events in paediatrics (Joint Commission Preventing Medication errors 2008). Many drugs used in paediatric cardiology are unlicensed, unavailable and/or require extemporaneous preparation. In addition, patients are often admitted from the ICU and are at a higher risk of medication error.

The clinical pharmacy service for the CHC plays a key role in medicines reconciliation from ICU, ensuring accurate medicine reconciliation and correct supply of medications for each patient. It has been found that pharmacists can positively affect medication reconciliation and education, assure consistency that results in improvements in patient satisfaction and medication adherence, and reduces medication errors (Milfred-Laforest S.K et al., 2013). Nationally, HIQA has published guidance for health and social care providers - Principles of good practice in medication reconciliation (2014).

Medicines reconciliation on admission to the CHC, and on discharge, is one of the main areas for the clinical pharmacist with a high level of discharge liaison between Crumlin and primary care. The CHC clinical pharmacist provides discharge liaison with community pharmacies to:

- Ensure ordering of the correct medication, so that all cardiology patients are standardised on a particular medicine in hospital and at home, reducing potential for administration errors
- Provide dosing information, such as medication administration charts, with instructions on administration of doses using tablets etc. and patient information leaflets
- Provide parent education

The CHC also provides information to other paediatric hospitals regarding protocols and dosing information for patients transferred. In addition, the pharmacist based in the CHC is often the first port of call for medical information enquiries from community pharmacies, general practitioners, clinical nurse specialists and non-consultant hospital doctors (NCHDs). This service is provided in conjunction with the medicines information pharmacist in Crumlin. There is no formal outpatient cardiology clinical pharmacy service.

Critical Care

There are two Paediatric Critical Care Units (PCCUs) in Ireland based in Crumlin and Temple Street. There are currently 32 PCCU beds across the two sites (Crumlin 23, Temple Street 9). Patients in PCCU require considerable clinical pharmacist input and this has been recognised at both sites by the allocation of pharmacy resources from their respective pharmacy departments. There has been a clinical pharmacy service in PCCU, since 2001 in Crumlin and since 2011 in Temple Street. The clinical pharmacist has been shown to be an essential member of the critical care MDT, providing not only clinical input with daily medication review for patients in the unit, but also showing benefit in reducing incidences of adverse events, costs and mortality rates (Bond and Raehl, 2007, Horn and Jacobi, 2006, Kopp et al., 2007, Krupicka et al., 2002, Montazeri and Cook, 1994, Silas and Tibballs, 2010, Schneider et al., 1998).

Crumlin PCCU pharmacists played a central role in the implementation of both electronic prescribing, via the newly introduced Clinical Information Management System (CIMS) and standardised concentration infusions (SCIs). Both of these interventions required the development of separate paediatric specific electronic drug files. The pharmacy department in Crumlin, in conjunction with the Crumlin CIMS project management team undertook to build these.

A recent cross-site project involving a consultant intensivist, PCCU pharmacist and nurse from each site successfully expanded the use of the Crumlin devised smart-pump library to include both Temple Street PCCU and the newly operational Irish Paediatric Acute Transport Service (IPATS). As a result of this, standardisation has been achieved for all paediatric patients requiring critical care management with continuous infusions. The supporting documentation and clinical governance structures to support this initiative require further cross-site input and development. In Crumlin, the need for pharmacy resources to enable the ongoing maintenance and further development of both these drug files has recently been addressed by the appointment there of an informatics pharmacist. This resource will need to further expand to allow Temple Street to implement electronic prescribing.

There are no national guidelines or standards with regards to pharmacy resources for PCCU. Currently, neither PCCU is in line with UK standards (Paediatric Intensive Care Society UK, 2010) nor adult recommendations (NCPCC, 2014, Society of Hospital Pharmacists of Australia, 2011).

Metabolic Medicine

While there is no dedicated pharmacist for this service, Temple Street is the National Centre for Inherited Metabolic Diseases. Due to the rare nature of these diseases, procurement of medications can require considerably more research, with the rarest drugs only available as health food supplements or laboratory grade chemicals. It is also occasionally necessary to procure specialised parenteral nutrition from the United States for some metabolic conditions when the patient is unable to take their nutrition orally or enterally. The pharmacy department coordinates the purchase of enzyme replacement therapy (ERT) for patients with lysosomal disorders (LSDs) throughout Ireland who are suitable for home therapy. Home therapy services are currently delivered through an external agent. Pharmacists have a key role in ensuring that selection of medications is appropriate for this group of patients, as often either the drug itself or the excipients in a medication can have an adverse effect in patients with specific diseases.

Neurology

In common with metabolic diseases, where licensed medications are found to be inadequate, research is required to procure unlicensed medicines. Pharmacists will also liaise with counterparts in other hospitals when there is limited information on the use of these medications in children. Occasionally, where medications are found to be inadequate in controlling seizures, patients are placed on a specific extremely restricted diet. Where this occurs, pharmacists work with dietitians to ensure that the excipients in their medications will not adversely affect their diet, and source alternative medications where required.

Parenteral Nutrition

Patient-specific Parenteral Nutrition (PN) is provided to patients who are unable to ingest or absorb oral or enterally delivered nutrients for a period of time. Due to the complexity of patient conditions, PN has become increasingly more important in patient long term survival. Home PN is also provided to patients nationally and involves the PN pharmacist working closely with local hospitals and the community to ensure continuity of care for these patients. There is a national contract for the manufacture of paediatric PN and a national PN steering committee both of which have paediatric pharmacy input. Crumlin uses European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) guidelines to keep up with international best practice, changes in recommendations and new developments.

The pharmacy Aseptic Compounding Unit (ACU) is involved in checking, order processing, and validation of each prescription to ensure that it is appropriate. ACU also liaises with staff at other hospitals nationally if patients are transferred between hospitals whilst on PN. A ward pharmacy service for PN is also provided on a daily basis which involves clinically evaluating the PN prescriptions and checking for suitability of PN, checking that patients are receiving the correct amount of PN, and carrying out audit on an ongoing basis. The PN ward pharmacist is also involved in PN education for staff at Crumlin and nationally and is involved in the national PN steering committee and Crumlin nutrition team/nutrition support committee.

Informatics and Medicines Information

The complexity of prescribing in paediatrics raises new challenges in the area of medication management as we move into an era of expanding use of information technology in healthcare. However this interface of ICT with medication use has potential to improve safety, efficiency and patient care. Pharmacy informatics is an emerging field and requires specific skills and resources. This has been recognised in Crumlin by the recent appointment of an informatics pharmacist. Further appointments are required nationally.

The informatics pharmacist in Crumlin has responsibility for:

- Maintaining and further developing the two electronic drug files created to facilitate the Computerised Physician Order Entry (CPOE) component of the CIMS and the smart infusion pumps currently in use in PCCU and theatre.
- Pharmacy lead on the cross-site standardisation of smart infusion pump drug library and standardised concentration infusions, including use on IPATS.
- Providing training for PCCU and anaesthetic NCHDs and other clinicians on electronic prescribing in PCCU, and the use of standardised concentration infusions as prescribed and administered using smart pumps.
- Overseeing the development of a paediatric clinical pharmacist intervention and medication errors software application.

The paediatric Medicines Information (MI) service strives to optimise patient care through the provision of evidence–based, impartial, evaluated, accurate information on medication use to health care professionals within the organisation. In the UK it has been shown that clinical advice from MI services to healthcare professionals had high levels of positive impact on patient care, outcomes and medicines safety (Innes 2014). Other roles of an MI service include the proactive provision of general information on the safe use of medicines, assessment of information on new medicines to inform decision making by prescribers and drugs and therapeutics committees, and to guide formulary preparation, risk assessing new products for use in a paediatric setting, adverse drug reaction reporting, contributing to protocol and guideline development, training and education.

Medication Safety

There is evidence to suggest that the prevalence of medication errors and corresponding harm is higher in children than in adults (Ghaleb 2010). This may be because most paediatric medication doses are calculated individually, based on the patient's age, weight and clinical condition, the use of adult dosage forms that require manipulation for administration to children and the frequent use of medicines "off-label" with limited dosing information. Furthermore, children are more susceptible to serious consequences from medication errors as a result of immature organ systems with less capability to buffer errors.

Medication safety programme's should be integrated into the hospital's overall patient safety and quality programme. It is led by the medication safety officer who together with the medication safety committee and unit based safety teams has developed an action plan to reduce medication errors. The action plan has been developed by balancing consideration of internal priorities and trends in medication error data with the external demands and concerns highlighted by various international and national safety agencies.

Priorities of a paediatric medication safety programme are:

- To embed a safety culture in the hospital, through the provision of medication safety training for staff involved in the medication process utilising a variety of teaching modalities such as e-learning programmes, interactive workshops with simulation.
- Regular communication to hospital staff regarding medication errors, including case examples, to increase awareness, the development of a smart phone application that will provide a single interface for the recording of clinical pharmacist interventions and medication error reporting.
- Devising strategies to minimise the risk of harm from high risk medicines (e.g. anticoagulants, insulin), the design of a new medication prescribing and administration record (MPAR), where required.
- Development and implementation of a medication reconciliation policy as recommended by HIQA (2014).
- Development of a medication safety self-assessment tool for acute paediatric hospitals that could also be used nationally.

Education, Training and Competencies

Currently there is no specialist training for PCCU pharmacists. The Hospital Pharmacists Association of Ireland (HPAI) is currently involved in negotiations with the Department of Health / HSE regarding the implementation of new career structures, as detailed in the Report on the Review of Hospital Pharmacy (2011). If successful, this will help to validate specialist pharmacist posts.

The Pharmacy Education and Training Reform Programme underway in spring 2013 comprised:

- Core Competency Framework for Pharmacists in Ireland published in August 2013 by the PSI. This document was designed to help provide a platform for the development of advanced/specialist practice frameworks.
- A continuous professional development (CPD) model was finalised in 2013, and in 2014 the new Irish Institute of Pharmacy (IIoP) was established at the Royal College of Surgeons in Ireland (RCSI).

The latter will facilitate training and education for specialisation and advanced practice.

Children with Intellectual Disabilities

Nationally and internationally there is a growing population of children and young adults with profound intellectual and multiple disabilities. Children with an intellectual disability may have multiple health problems. Some of their care needs will be obvious, but many are less evident and difficult to identify and diagnostic overshadowing can occur. Some individuals with intellectual disabilities suffer from poor physical health and there is a higher incidence of mental health disorders, epilepsy, sensory impairment, cerebral palsy and other physical disabilities. There is an unrecognised need for specialist paediatric pharmacists for this population group.

Pharmacy Services in Cork, Galway, Limerick, Sligo and Tallaght

Outside of Dublin, there is very little dedicated pharmacy service for children. The pharmacy department in Cork University Hospital (CUH) provides the pharmacy services for CUH and for Cork University Maternity Hospital (CUMH). The CUH Paediatric Unit is a major regional paediatric unit caring for children, from birth to 16 years, including acute paediatric admissions, children with chronic illnesses and children at risk. The paediatric unit has a 73 bed in-patient facility. The pharmacy department provides a mainly dispensary-based service to the 73 bed paediatric unit. There is no dedicated pharmacist WTE allocation for the paediatric unit at CUH. The pharmacy department strives to provide a clinical pharmacy service to the infants' and children's wards; however this service is severely limited due to the lack of a dedicated pharmacist allocation. Most of the pharmaceutical care that is currently provided to children and infants attending the paediatric unit is dispensary based where the procurement, storage and dispensing of medications occurs. This service is supported by the general pharmacy technician allocation for CUH/ CUMH, who provide a twice weekly top-up service.

Orders and prescriptions are checked in the dispensary for accuracy and clinical appropriateness; however this is not a comprehensive clinical check as access to the full patient profile is not available other than at ward level. Unlicensed, high cost and extemporaneous preparations are ordered by prescription by the medical team. Extemporaneous or specially compounded preparations are made in the dispensary when specialised formulations cannot be sourced.

Currently the CUH pharmacy department provides approximately 0.6 WTE pharmacists from the general pharmacist allocation to support a clinical pharmacy ward based service to the paediatric wards. There is no provision for leave cover which results in the unit having no pharmacist visit for a number of days at a time.

On a day-to-day basis, the Ladybird Infants' ward and the HDU beds are prioritised for medication chart review, medicine queries, stock issues, formulation enquiries, discharge planning, parent counselling and community pharmacy liaison. The Puffin Children's ward receives a limited clinical pharmacy service. Due to the inadequacy of the allocated resources, it is not possible to provide an acceptable level of service to the number of beds that are on the children's ward. Support for the paediatric day unit and the out-patient paediatric clinics (including CF, neurology, infusion, immunisation and allergy clinics) is dispensary-based. Ongoing pharmacist support for the paediatric unit includes guideline review and development, extemporaneous formulation review and staff education and training where possible.

The neonatal unit receives a twice weekly pharmacy technician top-up service from the 1 WTE CUMH pharmacy technician allocation. Non-stock dispensing and extemporaneous preparation is provided by the CUH dispensary. The 0.5WTE clinical pharmacist from the CUMH pharmacist allocation attends the NICU ward round each day, performs NICU daily medication chart review, co-ordinates and orders individualised parenteral nutrition, deals with any medication related issues and provides medication information to the neonatal unit staff as required. Currently, it is not possible to provide a medication chart review to the infants in the Intermediate Care and Special Care Baby Unit (SCBU), many of whom are prescribed complex medication. The clinical pharmacy service includes drug monograph and guideline development and review, as well as education and training for medical and nursing staff.

Paediatric medication queries for children or infants presenting to the Emergency Department or admitted to the General Intensive Care Unit are directed to the clinical pharmacists for those units, who do not have paediatric pharmacy training. Currently there is no Medication Safety Pharmacist at CUH and no dedicated Medicines Information Service to provide specialised support to the pharmacists allocated to the Paediatric and Neonatal Units.

In Galway University Hospital, 1.5 hours per day are allocated for 32 paediatric beds and 17 neonatal cots. As the paediatric clinical time for the pharmacist is limited, the pharmacist cannot review all paediatric patients. The pharmacist will see all patients on IVs, all patients with chronic conditions and all babies in the neonatal intensive care unit. There are paediatric IV monographs and a neonatal formulary. The neonatal formulary is shared with Portiuncula Hospital, Ballinasloe and Mayo General Hospital. There is a SARI pharmacist who will see any patient the paediatric pharmacist refers. The SARI pharmacist is involved in designing and updating the paediatric empiric antibiotic guidelines.

There are 77 paediatric CF patients in Galway University Hospital. The pharmacy service provided to these patients is drug-chart review on admission to hospital. The pharmacist also answers any medicine information queries from the CF nurse or consultant for outpatient clinics. There is a Medicines Safety Officer in Galway University Hospital, to whom medication errors are reported.

The pharmacy department in University Hospital Limerick (UHL), provides pharmacy services to approximately 50 paediatric beds, four paediatric high dependency unit beds and 25 neonatal cots. There is no dedicated paediatric pharmacist. The neonatal cots are off site at the maternity hospital which receives its drug supplies from the pharmacy department located in UHL. No pharmacist or pharmacy technician works on site at the maternity hospital. A senior clinical pharmacist was appointed in August 2015 to work within the hospital group maternity services to develop and implement antimicrobial stewardship. This pharmacist will, in the future, be on site in the maternity hospital to carry out SARI duties.

The paediatric wards receive a drug supply service from the pharmacy located at UHL. There is no clinical pharmacist service however the dispensary pharmacist can be contacted by phone for advice if required. UHL does not have a paediatric cystic fibrosis pharmacist. A business case was prepared and submitted for two senior clinical pharmacists to cover paediatrics and neonatology. To date no resource has been allocated.

Sligo Regional Hospital has an 18 bed paediatric ward. Currently the pharmacy department offers a 0.3WTE ward-based clinical pharmacy service. This encompases medicines reconciliation, review of inpatient drug therapy, sourcing and advising on choice of formulations, counselling parents and children prescribed new medication, facilitation of discharge and transfer to the community, and advising staff about medicines. The paediatric pharmacist sits on the Paediatric & Neonatal Specialist Management Team and is involved in reviewing & developing guidelines and protocols for the department.

In Tallaght Hospital, there is one WTE senior pharmacist. This role includes ward visits, policy/guideline development, formulary/new medicines, medicines information and dispensary duties. There is no clinical pharmacist for the paediatric emergency department although the senior pharmacist, as well as those in medicines information and the formulary development service, are available for input.

There is also 0.5 WTE pharmaceutical technician. This role provides top-up, non-stock dispensing and procurement of medicines. This is based on issuing about 10,000 medicines to paediatric inpatients out of a total of 320,000 per annum or 3.1% of total activity.

40.2 PROPOSED MODEL OF CARE

The reconfiguration of the Dublin children's hospitals into the Children's Hospital Group, and the future build of the new children's hospital will significantly impact paediatric pharmacy and the role it has in the national model of care. The integration of hospital paediatric pharmacy departments will approach the 'critical mass' of expertise outlined in the McKinsey review of tertiary paediatric services in Ireland. There will exist a genuine breadth and depth in paediatric pharmacy services due to efficient use of human resources, research, Information and Communications Technology (ICT), and capital resources. Paediatric pharmacy services will be a core component of an integrated medicines management system for Ireland's children and their families. It will play an important role in the delivery of pharmaceutical care to regional and local hospitals; community and home based settings, and significantly, will also provide enhanced support to primary care.

Specialist Pharmacist Role/Education

Paediatric pharmacy practice specialises in the delivery of patient care services by pharmacists that ensures the safe and effective use of medications for all children from neonates through to adolescents. The practice includes direct patient care for children, often provided through inter-professional healthcare teams, as well as advocacy and education for children and their families, wellness and health promotion, and activities that advance knowledge and skills in paediatric pharmacy (Board of Pharmacy Specialties – Paediatric Pharmacy, 2013). In 2011, a report on the Review of Hospital Pharmacy was published, which set out a new career structure for hospital pharmacists. This new structure recognises specialisation of hospital pharmacists, pharmacist service managers, deputy heads of department and directors of pharmacy. Such a structure would fit with the new paediatric service, which will have its centre at the new children's hospital with a number of outreach centres. Specialist pharmacists are already positioned to be a reference point at national level for the development of protocols and guidelines,

teaching in universities and as a reference point for other colleagues working in paediatrics. The future model of care should aim for equally high standards of pharmaceutical care in all settings that look after children and having such national structures will greatly help to facilitate this.

Links with university schools of pharmacy, medicine and health sciences will enhance practice development and progress towards formal recognition of paediatric pharmacy as a specialist post. This can be achieved by the creation of an accredited learning programme, e.g. Masters in Paediatric Pharmacy, specialist paediatric pharmacist residency and/or distance learning. Eligibility requirements, examination content and recertification will require an educational pharmacist resource with a dual clinical/academic role. At a minimum, the critical mass of expertise in pharmacy practice, research and education available in the new children's hospital should be made available as CPD to paediatric pharmacists working in regional and smaller hospitals who wish to enhance or refresh their learning. Paediatric residency graduates will serve their health care organisation as the ultimate resource for information about medicines used in the care of children and for decision making affecting the care of these patients. It is also timely to examine extended roles of practice for hospital pharmacists. To support this development, up-skilling of pharmacy technicians may be required. This work should be done in conjunction with the Pharmaceutical Society of Ireland.

Dispensary and Ward-based Services

This core service will expand to reflect the size of and complexity of services provided by the new children's hospital. A dedicated outpatient dispensing service will ensure seamless medicines management upon discharge to primary care. The outpatient dispensary will be located in a main patient facing area and provide specialised paediatric dispensing seven days a week at times that reflect peak emergency department, ward discharge and outpatient clinic activity.

The hospital pharmacist's role as a liaison between hospital care and care in the community is very important. Communication to the patient's community pharmacist about their medicines should be detailed and timely. Consideration should be made about the information needs of the community pharmacist so that they can accurately dispense the patient's prescription. The role of ICT needs to be developed in a large way to make this process more efficient. The current pathway for prescriptions of patients with medical cards needs to be reviewed to remove steps that are redundant and open opportunities for transcription errors to occur.

Healthcare providers should acknowledge the need for a formalised paediatric discharge pharmacy service in hospitals. Many children are prescribed medicines that are "off-label" or unlicensed. This may cause delays in getting their medicines on time when discharged. A small supply from the discharging hospital is often necessary to bridge the gap until supply can begin from their community pharmacy. Medication compliance aids are also frequently required in the form of medication advice charts when preparing doses is complex.

Increased utilisation of technology will require dispensary operation and management of unit dose packers, electronic data interchange, automated dispensing cabinets, dispensary robots, bar-coding and RFID solutions and electronic drug formularies. Close collaboration with medication safety, informatics and clinical leads will be required along with strict governance within the Children's Hospital Group and at national level. Specialties operating within and through the dispensary include medicines information, CF, cardiology, critical care, major burns, HIV, sickle cell etc. and are described below.

Antimicrobial Stewardship

Standardisation of antimicrobial prescribing is highly desirable nationally. This gradual standardisation of antibiotic therapy in paediatrics is a positive step and should lead to reduced rates of antibiotic resistance as well as improved patient outcomes. Use of standard electronic and hard copy guidelines is essential to achieve this goal and antimicrobial pharmacist will have a key role. Transfer of decision support to electronic prescribing systems is also a role for the antimicrobial pharmacist in conjunction with informatics and medicines information pharmacy services. Service evaluation will be achieved through clinical audit, PPS and antibiotic consumption data. All pharmacists with responsibility for antimicrobial stewardship should have access to structured training delivered at a national level. (SARI, 2009). Therefore regional and smaller hospitals will use the new children's hospital antimicrobial service as best practice reference and source of education and medicines information.

Cardiology

Expanded CHC pharmacy services will include.

- A senior clinical pharmacist with responsibility as paediatric cardiology lead, assisted by a basic grade pharmacist.
- Clinical pharmacist review of cardiology outpatients

This arrangement would allow the clinical pharmacy lead to develop and extend the current patient information leaflets provided to parents (in conjunction with the medicines safety pharmacist), and allow provision of evidence-based protocols and guidelines for use on the ward. The clinical lead would drive improvements in service provision with an aim of reducing medication errors, and auditing the service provided, identifying future areas of expansion. Such a service would ensure full ward cover during busy dispensary periods and leave within the current pharmacy opening hours.

In addition a clinical pharmacy lead, with support from the Department of Paediatric Cardiology, Crumlin could develop and implement an out-patient clinical pharmacy review for cardiology patients. Studies in adults have suggested a role for the clinical pharmacist review, particularly in heart failure patients (Milfred-Laforest SK et al., 2013). Such a service would transform the provision of clinical pharmacy cardiology services from ward-based to team-based in Crumlin.

Clinical Pharmacy

Medicines reconciliation has been proven in both adult medicine and paediatrics to reduce medication errors at admission and discharge. Nowhere is this more important than when dealing with children with complex diseases using highly toxic medicines. The clinical pharmacist has been shown to be an essential member of multidisciplinary teams, providing not only clinical input from their daily medication review for patients resident in the unit, but also showing benefit in reducing incidences of adverse events, costs and mortality rates (Bond and Raehl, 2007, Horn and Jacobi, 2006, Kopp et al., 2007, Krupicka et al., 2002, Montazeri and Cook, 1994, Silas and Tibballs, 2010, Schneider et al., 1998). Work in Tallaght by Grimes et al. has shown that assigning pharmacists to medical teams rather than specific wards is more effective. This facilitates better inter-disciplinary working and reduces serious medication errors at discharge. Such a collaborative model is novel in Irish hospitals but clearly is safer for the patient and should be further explored.

Clinical Trials (CT)

A national paediatric clinical trials service will be based at the new children's hospital and will cover haematology/oncology and general clinical trials. A CT pharmacist coordinator is required by law to oversee trial start-up maintenance and close down as well as dispensing to CT participants. Scope will exist to involve regional paediatric centres in trial as governance, resource and education issues will be sufficiently met. The treatment of childhood leukaemia has been the forerunner in the treatment of all cancers for the past 70 years and has shown the value of large multicentre clinical trials to refine and improve outcomes. Clinical trials continue to have a significant role in childhood cancers today.

While the EU Paediatric Regulation (2007) was aimed at improving the access to paediatric-appropriate medicines, the full effect of this has not been seen. This may place pressure on some specialist centres to engage in earlier phase clinical trials, in order to get access to novel therapies. Running clinical trials places a high administrative burden on the pharmacy service in terms of setting up of prescription templates, record keeping and dispensing. It is certain that a significant portion of the staffing and infrastructure of pharmacy in the future will have to be dedicated to running such clinical trials, in order to comply with the stringent regulations in place in the European Union.

Cystic Fibrosis

Senior full-time dedicated CF pharmacist posts are required to provide pharmaceutical care to CF inpatients and outpatients. These posts will include extended responsibilities such as improved monitoring of patient compliance, contributions towards pharmaceutical care, clinical guideline review, improved therapeutic drug monitoring and the introduction of a CF drug formulary within the current Crumlin formulary smartphone application. This role would assist in improving compliance and education for patients approaching transition to adult services.

Critical Care

There is a need for increased pharmacy resources in line with UK PICS Standards (2010):

- 0.1WTE post per level 3 critical care bed, at senior pharmacist grade or higher
- 0.07WTE post per level 2 critical care bed, at senior pharmacist grade.

Therefore, any further increase in number of beds in either PCCU or in the new children's hospital would require further additional resources. Adequate resourcing would facilitate the following:

- All patients in PCCU to receive a daily clinical pharmacy review of all medications
- PCCU pharmacists' attendance at morning and evening ward rounds. Currently PICU pharmacists rarely attend ward rounds due to time restraints, reducing the quality of the service provided by them to PICU and compromising the level of input from them to nursing and medical staff.
- Increase reporting of medication errors/incidents identified by PCCU clinical pharmacists as part of their regular review. Current resources mean that only the most serious incidents are reported.
- Extend the number of patients for whom individualised weaning schedules can be provided. Current weaning is sub-optimal and may be delaying extubation and discharge from PCCU.
- Medicine reconciliation on all admissions to, and discharges from, PCCU. The transcription from electronic to paper orders is a particularly problematic area.
- Allow all medication related guidelines and protocols to be completed and kept up to date

Appointment of a lead clinical PCCU pharmacist and informatics resources will allow review of current CIMS configuration with a view to implementation of electronic prescribing across the Children's Hospital Group and regional centres. Setting up of a joint PCCU pharmacy working group to agree clinical governance structures that will facilitate further standardisation of all guidelines, including intravenous administration guidelines electronic drug files, drug formulary and protocols. Provision of a pharmacy resource allocated to IPATS to assist in the development of guidelines for the stabilisation of all paediatric patients in non-specialist centres prior to transfer to a PCCU bed. Rapid access to accurate and clear medicines information is vital for non-specialist clinical staff having to provide emergency care to critically ill infants and children prior to transport to paediatric or neonatal intensive care.

Although adult national guidelines for management of brainstem dead donors for organ donation are in existence, paediatric specific doses and pharmaceutical management issues are not addressed within them – pharmacists could assist in drawing up paediatric-specific national guidelines. Expansion of current smart-pump drug library at both sites to ensure all medications given by infusion in PCCU (both continuous and intermittent) are administered via a smart-pump drug library. Upgrading and replacement of all current out dated patient- and nurse-controlled analgesia pumps to devices which facilitate dose error reduction software and a drug library.

Informatics

The migration to a digital hospital will require a significant reorientation of pharmacy services towards the creation, maintenance and governance of electronic healthcare solutions. The current pharmacy informatics role will greatly expand within the Children's Hospital Group and moving towards the digital new children's hospital. The creation of a paediatric EPR and CPOE with direct links to robotic, automated dispensing, packing, smart pump and bar-coding solutions, along with application and e-formulary development, necessitates pharmacist and technician involvement from design stage through to maintenance and future development. Governance of such systems is critical with version control and change request failures representing a significant patient safety issue. Pharmacy will work closely with medical and nursing informatics on build teams and will hold an administrator role in the management of drug files and formularies on behalf of the new children's hospital or national paediatrics drugs and therapeutics committee.

Short term goals:

- Implementation of national neonatal standardised concentration infusions in conjunction with, and under the auspices of, the National Clinical Programme for Paediatrics and Neonatology and the National Neonatal Transport Programme.
- Extend informatics pharmacy resources to include Temple Street to allow review of current CIMS configuration with a view to implementation of electronic prescribing at that site using the Crumlin drug file.
- Setting up of a joint PCCU pharmacy working group to agree clinical governance structures that will facilitate further standardisation including intravenous administration guidelines electronic drug files, drug formulary and protocols across both sites.
- Provision of a dedicated part-time pharmacy resource allocated to IPATS to assist in the development of online guidelines for the stabilisation of all paediatric patients in non-specialist centres prior to transfer to a PCCU bed.
- Extend the usage of smart-pump drug libraries to all general paediatric wards at both sites to ensure all medications given by infusion (both continuous and intermittent) are administered via a smart-pump drug library.

- Upgrading and replacement of all current out dated patient- and nurse-controlled analgesia (already in Temple Street) and epidural pumps to devices which facilitate dose error reduction software and a drug library.

Long term goals:

- Plans for the new children's hospital include it being a 'paperless' facility. This will involve considerable capital investment and will require significant pharmacy resources to implement a fully closed loop medication management system.

Medicines Information

The MI service in the new children's hospital will act as a national paediatric medicines information service which would act as a resource for regional centres for enquiry answering, protocol and guideline development and formulary management. The new children's hospital MI service would coordinate development of a national paediatric formulary and standardised national monographs for all injectable medicines. Service standards should be set and a competency framework for MI pharmacists should be developed to help identify ongoing training and development needs. The use of clinical decision support, data mining and archiving solutions will ensure a robust, quality driven service available to primacy, secondary and tertiary care. Medicines information will work closely with informatics, clinical pharmacy services, medication safety, research, education and formulary/ guidelines development.

Medication Safety

The medication safety officer will work closely with clinical risk to monitor the entire medicines management process with particular emphasis on safety culture, infrastructure, data, communication and training (Relihan et al 2012).

Resources to establish and operate the medication safety network include:

- Information: multi-resource websites, applications and update bulletins
- Event Investigations: root cause analysis, report writing, incident analysis
- Quality Improvement: establishment of safety measures, trigger tools and audit
- Education and training: study days, improvement stories
- Implementation of a closed loop medication administration system, use of smart infusion pumps and standard concentrations, use of automated dispensing cabinets, CPOE in all clinical areas, development of a joint paediatric formulary and national standardised guidance on the administration of injectable medicines will all require input from medication safety

The national paediatric EPR and electronic prescribing initiative and data mining will enhance the audit and reporting ability of the medication safety officer. Close cooperation with pharmacy informatics and medicines information will ensure decision support tools are designed, maintained and updated throughout the paediatric hospital network with best practice guidelines available in hard copy and electronic format for regional and smaller hospitals.

Parenteral Nutrition

With increasing numbers of patients requiring PN in hospital and at home, it is vital to have dedicated PN pharmacy resources to coordinate and manage the service at a national level; with collaboration from ACU, pharmacy informatics and MI on electronic PN prescribing and robotic compounding solutions. Education regarding PN will also form part of formalised paediatric CPD for regional and local hospital users in conjunction with the new children's hospital nutrition team and academic partners.

Pharmacy Services in Paediatric Haematology-Oncology

In the 1970s in the US, the demand for pharmacist expertise in the treatment of cancer was the first stimulus for the expanded role of pharmacists into areas such as aseptic compounding and clinical pharmacy services. This reflects the significant and complex pharmaceutical care needs of such patients, a phenomenon that continues to expand today. Crumlin is the national treatment centre for all paediatric cancers. To support the service, there is a specialist pharmacy team working to promote safe, efficient and timely use of complex drugs. Paediatric haematology-oncology pharmacy is a highly specialised discipline. Dosing is complex, based on patient weight, body surface area and age. Treatment protocols are intricate and require an in-depth knowledge of the drugs and their toxicity profiles.

Patients are diagnosed and have their treatment strategy prescribed by one of the specialist consultants at the hospital. Crumlin has a shared care arrangement with 16 hospitals around the country so that some of the care can be delivered close to the child's home. This includes routine blood tests, medical review in between treatment dates and in some cases, delivery of some element(s) of their drug treatment. Successful sharing of care demands good communication between the tertiary centre and the local hospital so that the patient's treatment journey goes smoothly. This model of care, with sufficient resources and ICT, could be explored for areas outside of haematology-oncology. It must be stressed that good communication in both directions is key to its success. The advent of a single health identifier and electronic patient record will also greatly facilitate shared care.

Aseptic Compounding Unit

The ACU prepares patient-specific doses of hazardous drugs in a controlled environment by trained technical staff. The treatment of cancer is changing. Alongside traditional cytotoxic drugs, newer treatments in the form of targeted therapies are being increasingly used. All of these drugs pose a risk to the health of any individual exposed to them. Biologics are increasingly being used to treat non-malignant diseases, e.g. inflammatory bowel disease, juvenile rheumatoid arthritis. This has placed greater work pressures on the ACU. An ACU is essential for any centre involved in haematology/oncology clinical trials as it has an important role to play in the preparation, labelling and accountability of Investigational Medicinal Products (IMPs), a role that cannot be performed by an outside body. The juxtaposition of the ACU and the haematology/oncology day unit facilitates good communication and rapid responses if treatment is needed to start in an emergency.

Future vision:

- Recognition of high level of responsibility of the pharmacists in aseptic compounding units and their specialist knowledge (Report on the Review of Hospital Pharmacy In Ireland, 2011)
- Expanded role for pharmacy technicians
- Increasing quality standards for ACUs
- Greater demand for therapies delivered via homecare as well as increasing day unit activity will pose capacity problems for many ACUs

Lack of capacity by licensed Irish commercial compounding companies is a concern should a hospital ACU have to cease production for some reason. Also full dependence on external compounding services is a risk in the event of production failure.

The Breckenridge Report (1976) recommended that all IV infusions be prepared centrally in the hospital by the pharmacy department. However, the National Patient Safety Agency (NPSA) in 2007 noted that Breckenridge remained largely unimplemented, except for cytotoxics and PN. NPSA recommended that all injectable drugs

be risk assessed and the identified risks managed appropriately. Not all high risk injectables are commercially available in ready-to-use forms. There is no capacity in most hospital ACUs to prepare such products in house and this is a concern. Products in question include electrolyte additions to intravenous fluids, infusions of opioids, sedatives and vasoactive drugs used in intensive care.

A centralised intravenous additive service (CIVAS) is required to meet the long term safety goals of unit dose dispensing and standard concentration of injectable drugs within the new children's hospital and its satellite centres. Such standardised unit doses are an integral component of closed loop medication systems. The risks and errors related to the preparation and the administration of the injectable drugs are numerous (Pharmacoeconomics, 1996). The standardization, then the centralization, of the preparations and reconstitution by the hospital pharmacy makes it possible to reduce these various risks and errors. The reconstitution of the intravenous treatments by a centralised intravenous admixture service guarantees the chemical stability and the microbiological quality of the ready-to-use injectable drugs and contributes to the quality and the total management of the care of the patient.

Electronic Prescribing – Haematology/Oncology

The importance of electronic prescribing in haematology/oncology and the resources that must be dedicated to it must not be underestimated. The clinical governance of such a system is key, with pharmacy in an administration role, it will fail if stakeholders do not engage at an early stage. Significant project failures have resulted from inadequate planning and build. Haematology/Oncology represents a separate build from standard EPR/CPOE systems although there will be linkage campus wide EPR/CPOE to include the general prescription and administration of non oncology/haematology medicines.

Pharmacy Services in Cork University Hospital/Cork University Maternity Hospital

A comprehensive paediatric clinical pharmacy service must be resourced and developed at CUH to ensure that patients attending the paediatric unit at CUH receive safe, effective and appropriate medications and optimal pharmaceutical care. This would allow a proactive, regular, clinical pharmacy ward-based service rather than the reactive dispensary-based service that is currently provided. It would also allow the further development of services that are already being provided.

Neonatal clinical pharmacy services should be resourced to provide a comprehensive pharmaceutical care service to all infants in the NICU, intermediate care, and SCBU. This additional resource would allow for daily review of all medication charts in the neonatal unit, participation in multidisciplinary team meetings and discharge planning.

Other service developments that require significant pharmacist input include:

a) Electronic prescribing is being developed as part of the Maternal and New-born Clinical Management System (MN-CMS) and it is essential that a clinical pharmacist is involved in this project at all stages: design, testing, training, launch, daily review, troubleshooting, updating, etc.
b) Neonatal standardised concentration intravenous solutions are being introduced in all paediatric and NICU and the increasing utilisation of smart pump technology requires pharmacist input to ensure safety and minimise the potential for medication errors.
c) Staff education and training needs are increasing in tandem with these developments

40.3 REQUIREMENTS FOR SUCCESSFUL IMPLEMENTATION OF MODEL OF CARE

Current Paediatric Pharmacy Staffing

Crumlin	WTE
Chief I Pharmacist	1
Chief II Pharmacists	2.2
Senior Pharmacists	7
Basic Grade Pharmacists	7.8
Total no of Pharmacists	18
Senior Technicians	7
Basic Grade Technicians	2
Total no of Technicians	9
Interns	2
Clerical/Admin	0.67
Porter	1
Total for unit	30

The pharmacy complement in Crumlin includes a Medication Safety Officer, Informatics Pharmacist (0.6 WTE), Med Information (0.5 WTE), and Aseptic Compounding Unit Pharmacists and Technicians.

Temple Street	WTE
Chief Pharmacist	1
Senior Pharmacist	2
Technicians	2
Pharmacist Aide	1
Admin Grade 4	1
Total for unit	7
Tallaght	**WTE**
Senior pharmacist	1
Pharmaceutical Technician	0.5
Galway University Hopsital	**WTE**
Pharmacist	1.5
University Hospital Limerick	**No dedicated paeds allocation**
Cork University Hospital	**No dedicated paeds allocation**

Recommended Paediatric Pharmacy Staffing

Recommended – new children's hosptial	
Core Pharmacy Staffing Requirements (including ACU)	
Pharmacy Services Manager/Director	1
Operations Manager/Deputy Pharmacy Manager-	1 x Chief I
Business/Retail Manager	1 x Chief II
Medication Safety Co-ordinator	1 x Chief II
Drug Information Pharmacist	1 x Chief II
Formulary Development Pharmacist	1 x Chief II
Clinical Pharmacy Services Manager	1 x Chief II
Education & Research Lead Pharmacist	1 x Chief II
Dispensary Manager	1 x Chief II
Senior Pharmacist – Clinical Trials	1
Research Pharmacist (University/Private Sector)	1
Senior Pharmacist	13
Basic Grade Pharmacist	6
Senior Technicians	11
Basic Grade Technicians	6
Porter/Pharmacy Aide	2
Secretarial/Admin	2
Pharmacy Interns	2
Informatics Pharmacy Staff	
Chief II Informatics	1
Senior Pharmacists	2
Senior Technicians	2
Analyst (IT/Pharmacy resource)	1
ACU/CIVAS Staff	
ACU/CIVAS Lead Pharmacist	1 x Chief II
Senior Pharmacist	4
Pharmacist	2
Senior technician	9
Technician	3
Total	**78 WTE**
This figure includes the pharmacy requirement for the satellite units in Blanchardstown and Tallaght, based on current planned service provision.	

Note:
For the new children's hospital, dedicated lead resources are required in key areas:
- medicines information (two WTE senior and one WTE basic grade pharmacist (rotational)),
- medication safety,
- informatics,
- education,
- research,
- haematology/oncology,
- cystic fibrosis,
- cardiology,
- PCCU (Paediatric Intensive Care Society (PICS) Standards for the Care of Critically Ill Children (2010): 0.07 to 0.1WTE Clinical Paediatric Pharmacists for each single level 2 or 3 intensive care bed. This equates in PCCU, Crumlin to 1.61 – 2.3 WTE for 23 beds, and in Temple Street to 0.63 – 0.9 with appropriate ward cover in their absence)
- clinical trials along with specialised dispensary,
- team based clinical pharmacy service leads with administrative support.

Outside Dublin

Cork:
- two WTE senior clinical pharmacists (paediatrics)
- one WTE basic grade pharmacist (paediatrics)
- one WTE pharmaceutical technician (paediatrics)
- one WTE senior clinical pharmacist (neonatology)

Galway: 1.6 WTE senior clinical pharmacists
Limerick: two WTE senior clinical pharmacists

Note
SHPA standards of practice for clincial pharmacy (J. Pharm Pract. Res. 2005;35(2):122-40 state the recommended clinical pharmacist to bed ratio for paediatrics is 1:30beds.

Infrastructure

A separate controlled area for paediatric medicines in regional and local hospitals is required.

Integrated ICT including CPOE (with decision support), automated dispensing systems, standard concentrations, electronic formulary and prescribing guidelines is required. There must be defined governance over all of these systems and throughout the model of care.

Education and Training

Formalised CPD and paediatric residency programmes leading to paediatric pharmacy specialty certification in conjunction with regional centres, new children's hospital and academic partners is required.

Interdependencies with Other Clinical Programmes

- Model of Care for Paediatric Critical Care
- Model of Care for Anaesthesia
- National Children's Research Centre

40.4 PROGRAMME METRICS AND EVALUATION

Performance monitoring is a continuous process involving collecting data to determine if the paediatric pharmacy service is meeting desired standards and targets. It is dependent on good quality information which can only be achieved by having a systematic process to ensure that data is collected consistently. The development and monitoring of key performance indicators (KPIs) and associated minimum data sets, which are specific and measurable elements of health and social care can be used to assess the quality of care. They are measures of performance, based on standards determined through evidence-based academic literature or through the consensus of experts when evidence is unavailable.

Sample KPIs:

- Percentage of medicines reconciliation forms (MRF) completed within 24 hours of admission and discharge.
- Percentage of restricted antimicrobials with appropriate indications and dosing.
- Medication incidents resulting in ISR 1 or 2 outcome
- Percentage of critical alerts bypassed in electronic prescribing system.
- Number of medication charts reviewed for paediatric wards and the neonatal unit on weekly basis.
- Percentage of discharge patients who receive seamless pharmaceutical care on discharge to home, to include specified tasks: patient medication profile chart, community pharmacist liaison.

The proposed paediatric and national electronic patient record (EPR), including CPOE, will have a significant impact on measures of performance with the ability to extract almost limitless data sets through 'data mining'. Data mining can help healthcare professionals identify effective treatments and best practices, and patients receive better and more affordable healthcare services. The huge amount of data currently generated by hospitals is too complex and voluminous to be processed and analysed by traditional methods. Data mining provides the methodology and technology to transform these mounds of data into useful information for decision making. This will directly feed into data set generation, KPI's and clinical audit.

40.5 KEY RECOMMENDATIONS

- Increase paediatric pharmacy staffing levels, in order to provide safe, accessible and effective services.
- Develop a robust national model of care for paediatric pharmacy.
- Formalise links between local, regional and tertiary paediatric pharmacy units.
- National guidelines or standards with regards to pharmacy resources for PCCU should be developed.
- Paediatric specific policies are required for the provision of pharmacy services to children.
- Increase pharmaceutical input to paediatric research and medicines management.

40.6 ABBREVIATIONS AND ACRONYMS

ACU	Aseptic Compounding Unit
CF	Cystic Fibrosis
CHC	Children's Heart Centre
CHIVA	Children's HIV Association
CIMS	Clinical Information Management System
CIVAS	Centralised Intravenous Additive Service
CPD	Continuous Professional Development
CPOE	Computerised Physician Order Entry
CT	Clinical Trials
DDD	Defined Daily Dose
EACS	European AIDS Clinical Society
EMP	Exempt Medicinal Product
EPR	Electronic Patient Record
ERT	Enzyme Replacement Therapy
ESPGHAN	European Society for Paediatric Gastroenterology, Hepatology and Nutrition
HIQA	Health Information and Quality Authority
HPAI	Hospital Pharmacists Association of Ireland
HSE	Health Service Executive
ICT	Information and Communications Technology
ICU	Intensive Care Unit
IIOP	Irish Institute of Pharmacy
IMP	Investigational Medicinal Products
IPATS	Irish Paediatric Acute Transport Service
KPI	Key Performance Indicator
LSDs	Lysosomal Disorders
MDT	Multidisciplinary Team
MI	Medicines Information
MPAR	Medication Prescribing and Administration Record
MRF	Medicines Reconciliation Form
NCHD	Non-consultant Hospital Doctor
NPSA	National Patient Safety Agency
PCCU	Paediatric Critical Care Unit
PENTA	Paediatric European Network for Treatment of AIDS
PN	Parenteral Nutrition
PSI	Pharmaceutical Society of Ireland
RCPI	Royal College of Physicians of Ireland
RCSI	Royal College of Surgeons in Ireland
SARI	Strategy for the Control of Antimicrobial Resistance in Ireland
SCI	Standardised Concentration Infusions
TCU	Transitional Care Unit
UK	United Kingdom
WTE	Wholetime Equivalent

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