

Review of General Surgery (Elective and Emergency Services)

Work Stream: Pre and Post-Operative Care- PACU Development

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The aim of the Pre and Post Operative Care work Stream is to support the overall aims of the General Surgery Review

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1. Executive Summary

The development of PACU Anaesthetic Care Units for Northern Ireland

The development of Post Anaesthetic Care Units (PACU) is part of the wider Pre and Post-Operative Care work stream which aims to support the General Surgery Review.

Enhanced PACU can be described as level 1+ or level 1.5 care, it is an intermediate level of care where a higher degree of observation, monitoring and interventions can be provided for patients than in a general ward but not requiring HDU / organ support.

PACU beds are for patients who do not meet the criteria of an HDU or ICU bed, but who cannot be safely managed in a ward.

Enhanced Perioperative Care is part of the planned surgical patient's pathway. It is supported by the General Surgery Review, Royal College of Anaesthetists (ROCA), Faculty of Intensive Care Medicine (FICM) and the Association of Surgeons in Great Britain and Ireland.

Enhanced perioperative care supports the delivery of holistic, high-quality care to surgical patients at increased risk of adverse outcomes. Enhanced care services should provide benefit to patients (reduced likelihood of cancellation and postoperative complications) and to systems (more efficient care, reduced length of stay and reduced pressures on critical care services. In the midst of the COVID-19 pandemic, there are obvious benefits of creating Enhanced Perioperative Care Services, to deliver the best quality care, even when critical care units are at or above their baseline capacity. A PACU pilot has been delivered on BCH site, which has also provided learning which will be considered as part of this report.

Methodology

There are two broad categories of patients who present for surgery, 1) elective patients who can have their admission and surgery at a predetermined and predictable time; and 2) acute patients whose presentations are unpredictable and often requires fast intervention either in the urgent or emergency setting¹.

While it recognised that the Outcome of the General Surgery Review will confirm the future service models of general surgery and any impact on future PACU bed needs, this paper considers the beds required based on current service profile of complex surgery and service needs and considers:

- The types of procedures that could be managed in a hospital
- The levels of these procedures that currently take place in each of our units
- Length of stay profiles of elective patients admitted to critical care for less than 1 day and less than 2 days by unit;

- Emergency operative surgical patients, who could meet the criteria of a PACU and consideration of whether these patients could be managed in a PACU.
- Elective operative patients outlining in theatres as no critical care bed is available;
- Information on RPROG elective patients for unmet need

Analysis of this information will provide the first Phase of PACU bed requirements. The plan would be that bed requirements could be considered again once the Phase 1 PACU are established and evaluated in 2022/3 year.

Phasing the beds also will allow staffing to be trained appropriately enabling the service to be developed to meet the needs of each Trust. This means there will be more efficient use of the skilled theatre nurses and recovery nurses.

The estimated number of beds to be established in Phase 1 can be seen in Table 1. These recommendations are based on the principles of the national “Guidance on Establishing and Delivering Enhanced Perioperative Care Services” and similar UK models and are based on the premise that PACU is:

- A targeted approach to reduce perioperative morbidity and mortality and improve patient reported outcomesⁱⁱ.
- An approach complementing existing best practice pathways of care such as Enhanced Recovery
- A time limited intervention, with the expectation that the majority of patients will be discharged from a PACU facility within 12-24 hours, with a small number staying for a maximum of 48-72 hours.
- An integral component of the continuum of care between care on surgical wards and Critical Care.
- A PACU service should not be considered as a staging post to Critical Care nor should it be planned as routine step down from Critical Care or a ‘recovery from anaesthesia’ unit.

Adhering to these principles will improve the efficiency of the service, as length of stay on an EPC facility will be largely predictable. However, it is acknowledged that length of stay (and hence patient flow) will also depend on the staffing and competencies of the receiving discharge ward. This paper will not address this discharge surgical wards needs as these should be seen as part of routine needs assessment of surgical pathways and services.

PACU Units Required

By considering the surgeries performed, the number of elective patients being admitted into critical care for less than 36 hours and the number of theatre outliers, it is recommended that the following PACU Units be developed:

Table 1: Phase 1 PACU Units

Trust	Hospital	Estimate of PACU Beds Required based on Current Information, size hospital and profile of services	Phase 1	Phase 2 additional beds
Belfast Trust	Belfast City Hospital	4-6	4	2
	Royal Victoria Hospital	4-6	4	2
	Mater Hospital	2		2
Northern Trust	Antrim Hospital	3-4	3	1
	Causeway*	2		2
Southern Trust	Craigavon	3-4	3	1
South Eastern	Ulster Hospital	4	4	
Western Trust	Altnagelvin	3	3	
	SWAH*	2		2
Total		29-33	21	12

* Clarity will be required on impact of Critical Care

Workforce Needs

PACU staffing is a problem for managersⁱⁱⁱ as they seek to overcome obstacles that may affect the constant onward flow of patients back to the wards.⁹ The PACU is a busy working area in which nurses may communicate with patients, family members, and a large team of perioperative professionals.¹⁰⁻¹²

According to the Association of Anaesthetists of Great Britain and Ireland (AAGBI) recommendations, the PACU must have sufficient number of trained staffs throughout all operating hours, and it must be open for 24 hours for emergency surgical services. There should be a minimum of two caregivers for a single patient in the PACU.^{9,15,16}

Patients unable to maintain their airways must be nursed continuously on a one-to-one basis as routine practice, even in peak periods. Cardiovascular and respiratory monitoring should be applied and clinical conditions should be observed. Delivering Care aims to support the provision of high quality care which is safe and effective within hospital and community settings, through the development of a framework to determine staffing ranges for the nursing and midwifery workforce. The current phase of the framework is critical care, theatre and recovery staffing. The nurse skills and competencies for PACUs is being developed in conjunction with the outcome of this phase of Delivering Care to ensure that staff needs and grading are in line with recommendations for nursing.

While there is no standardised approach to PACU we have considered the following workforces principles:

Principles around PACU workforce

- PACU will function with shared responsibility between surgical and anaesthetic teams for the medical care of the postoperative surgical patients. It will therefore not be a stand- alone facility.
- All patients reviewed by both surgical and anaesthetic teams prior to discharge to ward setting.
- PACU Nurse staffing needs should be considered as part of Delivering Care for Theatres and Anesthetists.
- Staffing associated with PACU will be part of the theatre team but advice and support will also be available from the critical care team.
- Specific training and professional development will be

The workstream has considered the workforce required for a 4 bedded unit based on the PACU pilot in BCH and other PACU units in establishment in the UK. Table 2 below outlines the staffing structure needs to be used in Phase 1 for a 4 bedded unit.

Table 2: Phase 1 Staffing Workforce

Trust	Hospital	PHA Beds Phase 1	Nurse Staffing RN	Nurse Staffing HCA	Physiotherapist	Pharmacists
Belfast Trust	Belfast City Hospital	4	7.94	3.96	0.5	0.25
	Royal Victoria Hospital	4	7.94	3.96	0.5	0.25
	Mater Hospital					
Northern Trust	Antrim Hospital	3	5.96	2.97	0.38	0.19
	Causeway*					
Southern Trust	Craigavon	3	5.96	2.97	0.38	0.19
South Eastern	Ulster Hospital	4	7.94	3.96	0.5	0.25
Western Trust	Altnagelvin	3	5.96	2.97	0.38	0.19
	SWAH*					
Total		21	41.685	20.79	2.625	1.3125

Equipment and Facility Needs

An estate and equipment review is being considered in the proposed units to determine what is required to meet the needs of safe and effective physical requirements of a PACU unit, its links to recovery and critical care. Within each hospital and this should be carried out as part of the Phase 1 Implementation Plan.

Governance Arrangements

Establishment of the Governance arrangements around the PACU including and not inclusive of:

- Standard Operating Procedures can be seen in Appendix 4, but may need to be reviewed by Trusts to take account of individual circumstances.
- Establishment of administrative processes and who manages the PACU and monitors its outputs will need to be considered as part of an implementation plan but is likely going to be Trust specific.
- Development of arrangements for those Trusts with multiple theatres in different buildings will need to be established by Trust management.
- Role and arrangements for Critical Care Outreach Team, if required.

The governance arrangements of each unit will need to be considered as part of the implementation of beds. The monitoring of these beds should form part of the PACU Implementation Workstream and will be part of the post project evaluation when the beds are in place.

Other considerations

Establishment of a link into critical care services should be part of implementation. This should include an understanding of the arrangements for critical care outreach services and how these can be made robust to support PACU when there are challenges.

Review other enhanced care beds availability in the Trust to determine if joined models are most appropriate.

The PACU models will need to link to the Critical Care Needs Assessment Workforce Plan due to be complete by March 2022¹ and the levels of care determined by the needs assessment for each of the units.

Recommendation

The Pre and Post Op Workstream Group recommend there should be the establishment of PACUs across Northern Ireland, initially in all DGH undertaking complex surgery meeting the agreed criteria.

It is recommended that PACUs should be established in a phased approach

The Pre and Post Op Workstream Group asked that funding for establishment of PACU beds be considered at high priority Departmental level, and the Director of Commissioning has submitted a paper in support with respect to this. This is in line with the proposed bed numbers within this paper.

It is recommended that bed numbers in phase 1 be based on Table 1, it should be recognised that going forward PACU bed requirements are likely to be between those in Methodology 2 and 3.

¹ COVID permitting

The location of PACU beds should remain flexible until such times as the finalisation of the General Surgery Review and a clear picture of where complex surgery will take place. The Phased approach of implementation may help with this.

An implementation Team should be set up to take this initiative forward once approval is given.

Emergency surgery patients may also benefit from a PACU and the development of PACU beds in a phased way may help determine which patients should be included first in this initiative;

The Implementation Team should ensure there are effective SOPs in place in each Trust with clear protocols for admission, discharge, treatments and patient pathway,

Ongoing performance monitoring should be established to ensure all patients using the PACU facilities are benefiting from the enhanced recovery model. The Implementation Team should ensure systems are in place to monitor staffing, patient population and outcomes. [8.9.17.18](#)

Conclusion

Post-operative morbidity and mortality among high risk patients is high, and a significant burden on health care resources. The PACU aims to improve the structure and facilitate the processes essential to provide the best quality, evidence based post-operative care. ^{iv} By identifying those patients who are high risk before surgery and determining which procedures would benefit from a planned admission into a PACU unit, hospitals may reduce the risk to patients receiving surgery and reduce the number of patients requiring HDU / ICU care.

It should be noted that Musgrave Park Hospital, Paediatric Services and Emergency Services have been excluded from the recommended bed numbers and may need to be considered as PACUs develop in the future.

It is highly recommended that PACU Units be established in each DGH Hospital in Northern Ireland who carries out complex surgery.

2. Background

Surgery is an important treatment option for a wide range of acute and chronic diseases and conditions.

Around 110,000 patients undergo a surgical procedure each year in Northern Ireland and this number will continue to rise, with increasing demand and increasing complexity of surgical procedures. As at December 2020, over 323,000 people were waiting to see a consultant, with 105,000 waiting for surgery. This amounts to 1 in 4 people waiting for a first consultation or a procedure in Northern Ireland.^v

For most patients' surgery is a success, both in terms of the procedure itself and the care before and afterwards. However, not all surgery results in a successful outcome. Evidence would indicate that 15% of these surgeries would be deemed as "high risk".^{vi} These high-risk patients account for more than 80% of the inpatient surgical deaths^{vii} in Northern Ireland. Fortunately, it is a rarity that patients do not survive an anaesthetic, the difficulty often begins in the post-operative period when their medical comorbidities take their toll. Postoperative care is the management of a patient after surgery. This includes care given during the immediate postoperative period.

Defining Risk

The NCEPOD report^{viii}, Knowing the Risk of the Perioperative Care of Surgical Patients. looked at patients receiving surgery and identified that around 20% of patients were high risk. In each case Anaesthetists were asked to risk assess the patients from their own knowledge and skills to determine risk, however this showed there was a variation in how patients' risk was assessed and recommended a UK-wide system should be introduced that allows rapid and easy identification of patients who are at high risk of postoperative mortality and morbidity.^{ix}

Nice Guidelines NG45^x covers routine preoperative tests for people aged over 16 who are having elective surgery. While its primary aim is to reduce unnecessary testing, to do this it advises which tests to offer people before minor, intermediate and major or complex surgery, taking into account specific comorbidities (cardiovascular, renal and respiratory conditions and diabetes and obesity). Thereby classifying the complexity of surgery.^{xi}

One of the principal recommendations of NCEPOD was that "is a need to introduce a UK wide system that allows rapid and easy identification of patients who are at high risk of postoperative mortality and morbidity." (Departments of Health in England, Wales & Northern Ireland

"Existing risk stratification tools have limitations and clinical experience suggests they are not used routinely"^{xii}. In 2011, the 'Knowing the Risk' report on the perioperative care of high-risk surgical patients was published by the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) (Findlay et al, 2011). This found a low incidence of the mortality risk being documented on the consent form for surgery, which lead to recommendations for:

1. A method to rapidly and easily identify high risk patients
2. Critical care resource planning
3. Discussion and preoperative documentation of risk with patients ^{xiii}

The Surgical Outcome Risk Tool (SORT) is a relatively new preoperative tool, having first been described in the British Journal of Surgery in November 2014 (Protopapa et al, 2014). It is a simple tool that can easily be implemented into routine clinical practice: in conjunction with the name of the intended surgical procedure, only six, solely preoperative, easily obtainable variables are required to calculate the mortality risk of adult patients within 30 days of inpatient surgery. A web-based version followed shortly thereafter, second version of the SORT was published on 15 October 2020 and can be found at [Surgical Outcome Risk Tool \(SORT\) - SOuRCe / NCEPOD \(sortsurgery.com\)](https://www.sortsurgery.com/).

While more recent research indicates that combining subjective and objective measurement using the SORT provided an even more accurate estimate. However, it recognises that the sort tool is a useful tool to plan surgical services, including the number of critical care and post operative enhanced beds required to serve a surgical population.

What are Post Anaesthetic Care Units (PACU) and why is there a need?

Post Anaesthetic Care Units (PACU) provide the best pathway for patients with monitoring, treatment or care needs which are greater than those that can be provided on normal postoperative wards, but who are not expected to require Level 2 or 3 (critical care) interventions or staffing to meet their care needs.

What Post Anaesthetic Care Units (PACU) are Not?

PACU services are not for patients at immediate risk of deterioration and are not a substitute for or step down from critical care. Instead, they bridge the gap between existing ward and critical care facilities, allowing high risk patients to be managed safely in an appropriate environment dependent on their needs. However, it is recognised that if these facilities are not in place, then high risk patients are more likely to be manage in high dependency areas.

As such, it is expected that as well improving the quality of care and safety of high-risk surgical patients, the development of PACU facilities will also release critical care capacity previously used to support initial postoperative care for high-risk patients. This also means that there will be increased protection of surgical capacity during times of increased critical care activity, such as during emergency surges or winter pressures, it will also reduce 'last minute' cancellation of inpatient surgery, for which one of the biggest risk factors is patients requiring postoperative critical care^{xiv}.

National, Regional and Local Context

Post Anaesthetic Care Units are not a new concept and have been evidenced as providing a positive impact to the management of high-risk surgical patients in the

UK. The role of a PACU Unit as part of a patient's integrated surgical pathway has been evidenced by:

1. Royal College of Anaesthetists^{xv}
2. Royal College of Surgeons in Great Britain and Ireland;
3. Royal College of Surgeons
4. National Institute for Health and Care Guidance (NICE)^{xvi}
5. Centre for Perioperative Care^{xvii}

However, with the exception of Belfast City Hospital, where a PACU service is currently being piloted, these units have not been developed within Northern Ireland.

The Task

The Pre and Post Operative Care Workstream of the General Surgery Review has allowed stakeholders from across Northern Ireland to consider:

- proposed models of PACU delivery which are in line with best practice and endorsed by Royal College of Surgeons, Association of Surgeons in Great Britain and Ireland and the Royal College of Anaesthetists;
- the role of the PACU service within current service models in Northern Ireland,
- broad criteria / principles for patients' suitability and unsuitability for admission into PACUs.
- the scope of patients which could be appropriately managed within these facilities.

Following these initial considerations, the PACU working group has now moved on to:

- consider the admission criteria of patients into PACU facilities;
- collate data to predict the likely demand for PACU beds within each hospital unit, so that a regional business case can be developed to provide PACU bed needs across NI for hospitals providing high risk surgery;
- consider, develop and agree a workforce framework for PACU with PHA, and a gap analysis of workforce requirements;
- consider education and upskilling requirements for nursing and AHPs.
- consider likely impact of the PACU development on critical care, theatre outliers and surgical units.

Terms of Reference of the Work stream can be seen in Appendix 1

Membership of the Work Stream Title: Post-Operative Care

The workstream was chaired by Janet Johnson, supported by Paula Tweedie with Martin McCormick providing Clinical expertise. It included membership from each Acute Trust in Northern Ireland, Department of Health, Health and Social Care Board and Public Health Agency.

It also included membership from the key personnel of multidisciplinary surgical team including anaesthetists, surgeons, nursing, allied health professionals, managerial

staff, human resource professionals, Commissioning and Finance staff from across Northern Ireland.

Membership can be seen within the Terms of Reference in Appendix 1.

3. Data Collection

Information for the modelling was used from existing data from the Department of Health Website and from the Theatre Management System (TMS). Further information on the data used and how this was adapted to meet the needs of the analysis can be seen below and in Appendix 3.

The following variables were used from this Theatre Management System (TMS).

Variables Used

A number of variables are likely to determine whether a patient will need to be managed in PACU. These include:

1. Age Group: Age group is split on likely resource need for patients <65 years, 65-79 years old and 80+ years
2. Procedure carried out and the intended management of the patient. It is unlikely that daycase procedures will ever require a PACU unit.
3. Scoring of procedure severity. There has been a number of attempts to classify procedure and these can be seen in Appendix 7. Part of this research will look at ASA scoring as methodology. A model based on ASA scoring is recommended by NCEPOD and this will be discussed below. In summary this scoring is summarised by NCEPOD as follows.
 4. ASA-PS scoring
 - Grade 1: A normal healthy patient
 - Grade 2: A patient with mild systemic disease
 - Grade 3: A patient with severe systemic disease
 - Grade 4: A patient with severe systemic disease that is a constant threat to life
 - Grade 5: A moribund patient who is not expected to survive without the operation.
5. Type of Procedure Group.
6. Patients' other co-morbidities such as patients with a cancer diagnosis
7. Clinical Urgency.

Clinical urgency is based on the NCEPOD classification of intervention (2004)

 - IMMEDIATE - Immediate life, limb or organ-saving intervention - resuscitation simultaneous with intervention. Normally within minutes of decision to operate
 - URGENT - Intervention for acute onset or clinical deterioration of potentially life-threatening conditions, for those conditions that may threaten the survival

of limb or organ, for fixation of many fractures and for relief of pain or other distressing symptoms. Normally within hours of decision to operate.

- EXPEDITED - Patient requiring early treatment where the condition is not an immediate threat to life, limb or organ survival. Normally within days of decision to operate.
- ELECTIVE - Intervention planned or booked in advance of routine admission to hospital. Timing to suit patient, hospital and staff.

Ensuring the Accuracy of the Data and standardising the Data -

Much of the data used for modelling came from the Theatre Management System (TMS). A cursory examination of the data revealed a number of errors, incomplete records and a lack of standardisation within the dataset. The 134,000 record dataset was analysed further and the information evaluated to consider the impact of these errors on the outcome of the study. Where possible additional fields were added to the dataset to standardise the records across Trust, address any missing records and rectified errors were possible. This was particularly important in the following areas:

1. Calculation of time

There were 329 records without Anaesthetic start date and time. Blank Anaesthetic Time was important to calculate if surgery took ≤ 2 hours or more than 2 hours.

On further examination only 301 of these records had patients who had a general or spinal anaesthetic and 12 of these records were elective, the impact on the outcome was therefore considered negligible.

It was noted however that similar records were available for operation start time, procedure start time, main op start time and for the 329 records which did not have an anaesthetic start time operation / procedure start time was used to calculate an additional field was also added that used the start Anaesthetic start date and time if the minutes under anaesthetic were less than 2 hours or more than 2 hours.

2. ASA Grade Code was blank

There were 9229 patients in 2018/9 and 8806 patients in 2019/20 which had a blank ASA Code with 13.5% of elective patient records having a missing code.

Table 3: TMS Information for 2018/9 and 2019/20 by ASA Code

ASA Code	FY2018/2019		FY2019/2020	
	Elective	Non Elective	Elective	Non Elective
1	11561	7046	9973	6311
2	18010	7583	15763	7445
3	8198	5199	7169	5251
4	1067	1845	1133	2062
5	5	177	6	161
6		27		25
(blank)	6065	3164	5666	3140
Grand Total	44906	25041	39710	24395

Of the 6065 blank elective ASA scores within the database in 2018/9 and 5666 in 2019/20, analysis showed that the majority of these patients would not be included in the analysis for Methodology 2 and 3 as only 451 elective patients in 2018/9 and

394 elective 2019/20 had an anaesthetic type of GA, Spinal, Epidural, Nerve or Regional Block. The remaining patients were managed via local anaesthetic or with Entonox or throat spray. These patients do not meet the criteria for inclusion in methodology 2 and 3 as the patients most likely categorised as <1% risk.

Table 4: Patients classified with a Blank ASA Code in the Theatre Management System

Anaes Type	FY2018/2019			FY2019/2020		
	Elective	Non Elective	Total	Elective	Non Elective	Total
GA	380	98	478	334	78	412
Spinal, Epidural, Nerve or Regional Block	71	43	114	60	34	94
ENTONOX	547	7	554	438	13	451
Local Anaes	3732	1505	5237	3361	1520	4881
No Anaesthetic Given	208	540	748	237	572	809
Other	72	24	96	58	23	81
Sedation	418	276	694	309	304	613
Throat Spray	637	671	1308	869	596	1465
Grand Total	6065	3164	9229	5666	3140	8806

Further information on the 6065 patients can be seen in Appendix 3

Following discussion and to ensure that the data included all relevant information, patients with a blank ASA Code who had an anaesthetic type of General Anaesthetic and spinal were categorised individually taking account of age of patient, specialty and time in theatre to determine risk.

The impact of removal of patients receiving local anaesthetic reduced the dataset to 109,219 as outlined below.

Table 5: Classification of Patients Anaesthetic in the TMS dataset

	FY2018/2019		FY2019/2020	
	Elective	Non Elective	Elective	Non Elective
General, Spinal, Regional Anaesthetic	35880	21033	31831	20475
Other – Throat Spray, Local, Entonox, sedation , no anae, other	9026	4008	7879	3920
Grand Total	44906	25041	39710	24395

3. Assignment of Surgical Type for Methodology 2 & 3

NCEPOD's SORT looks at the following variables, while SORT2 adds consultant expertise to this information. Data was sourced from Theatre Management System databases to test the need for PACU beds based on these variables. While it is recognised that there are data accuracy issues within this data, work was originally carried out to eradicate as many data issues as possible and standardise the information to make it more user friendly and ensure as much accuracy as possible. This exercise sought to provide an estimate of the number of patients within certain risk categories.

Age Group

Age group is split on likely resource need for patients <65 years, 65-79 years old and 80+ years

Table 6: TMS Information for 2018/9 and 2019/20 by Age Group

Row Labels	FY2018/2019		FY2019/2020	
	Elective	Non Elective	Elective	Non Elective
General, Spinal, Regional Anaesthetic	35880	21033	31831	20475
66-80	7428	3363	6705	3610
80+	1397	2038	1369	2081
Age <= 65	27055	15632	23757	14784
Other - Throat Spray, Local, Entonox, sedation , no anae, other	9026	4008	7879	3920
66-80	2773	1080	2416	1057
80+	1175	628	989	634
Age <= 65	5078	2300	4474	2229
Grand Total	44906	25041	39710	24395

Surgical Severity

Minor, moderate, major or complex major

The online SORT tool utilises the AXA PPP procedure database to classify the surgeries.

Further information regarding surgical severity coding can be found at <https://online.axapphealthcare.co.uk/SpecialistForms/SpecialistCode.mvc>

High risk Specialties

Thoracic, GI or vascular

Cancer

Active malignancy within past 5 years

ASA-PS scoring

Grade 1: A normal healthy patient

Grade 2: A patient with mild systemic disease

Grade 3: A patient with severe systemic disease

Grade 4: A patient with severe systemic disease that is a constant threat to life

Grade 5: A moribund patient who is not expected to survive without the operation.

Clinical Urgency

Clinical urgency is based on the NCEPOD classification of intervention (2004)

IMMEDIATE - Immediate life, limb or organ-saving intervention - resuscitation simultaneous with intervention. Normally within minutes of decision to operate

URGENT - Intervention for acute onset or clinical deterioration of potentially life-threatening conditions, for those conditions that may threaten the survival of limb or organ, for fixation of many fractures and for relief of pain or other distressing symptoms. Normally within hours of decision to operate.

EXPEDITED - Patient requiring early treatment where the condition is not an immediate threat to life, limb or organ survival. Normally within days of decision to operate.

ELECTIVE - Intervention planned or booked in advance of routine admission to hospital. Timing to suit patient, hospital and staff.

Table 7: Clinical Urgency of Patients within the TMS system

Clinical Urgency	FY2018/2019		FY2019/2020	
	Elective	Non Elective	Elective	Non Elective
ELECTIVE	35880		31831	
EXPEDITED		11673		11537
IMMEDIATE		1254		1243
TRAUMA		1496		1331
URGENT		6610		6364
Grand Total	35880	21033	31831	20475

The “Guidance on Establishing and Delivering Enhanced Perioperative Care Units” recommended that patients with a perioperative risk prediction of > 5% should be admitted to an Intensive Therapy Unit (ITU) postoperatively, those with a risk between 1-5% should be cared for in an Enhanced Perioperative Care (EPC) unit and those with a predicted risk of <1% could be safely managed in a standard ward. The exercise therefore sought to categorise cases from the TMS data into these risk groups using the SORT tool. However, as the full details of individual cases were not available, the following assumptions were made:

- Cases taking longer than 2 hours were likely to be due to cancer for most specialties, excluding orthopaedics. This will overestimate the numbers for cancer in some circumstance (e.g. bowel resections for cases of severe inflammatory bowel disease), but it was not felt that this detail would materially affect the risk group (see discussion below).
- Cases in all groups lasting longer than 2 hours were classed as “complex major”. This was suggested by a member of the group and achieved consensus amongst the group. Perusing the AXA PPP database for examples of complex major surgeries (for example any bowel resection surgery) confirmed this as a reasonable assumption
- Orthopaedic cases taking longer than 2 hours are classified as “complex major”. Most straightforward joint replacements will be under the 2 hour mark, but revision surgery or more complicated anatomy (e.g. previous fractures/ sarcoma resections) will likely take longer than this time.
- Major urology/ onco-gynaecological cases (e.g. cystectomies/ complex nephrectomies/ cytoreduction surgeries) were treated as high-risk specialties as they can often involve gastrointestinal or vascular disruption or were clinically thought to have a similar risk profile.

Utilising these assumptions, the following tables summarises the conditions that would lead to the various risk categories for most specialties meeting the criteria of being in the intra-abdominal (including vascular) and airway group (Table 8) and the Trauma and Orthopaedic group (Table 9):

Table 8: The Surgical Outcome Risk Tool (SORT) for intra-abdominal and Airways

ASA Grade	Surgery duration	Age Band		
		Age <= 65	66-80	80+
1	Less than 2 hours	<1%	<1%	<1%
	More than 2 hours	<1%	<1%	1-5%
2	Less than 2 hours	<1%	<1%	<1%
	More than 2 hours	<1%	<1%	1-5%
3	Less than 2 hours	<1%	0.5-1%	1-5%
	More than 2 hours	1-5%	1-5%	>5%
4	Less than 2 hours	1-5%	1-5%	>5%
	More than 2 hours	1-5%	>5%	>5%

Table 9: The Surgical Outcome Risk Tool (SORT) for orthopaedic/ fracture excluding Musgrave Park

ASA Grade	Surgery duration	Age Band		
		Age <= 65	66-80	80+
1	Less than 2 hours	<1%	<1%	<1%
	More than 2 hours	<1%	<1%	<1%
2	Less than 2 hours	<1%	<1%	<1%
	More than 2 hours	<1%	<1%	<1%
3	Less than 2 hours	<1%	<1%	1-5%
	More than 2 hours	<1%	<1%	1-5%
4	Less than 2 hours	<1%	1-5%	1-5%
	More than 2 hours	1-5%	1-5%	1-5%

This is obviously a simplification of the situation but allows an approximation of demand. As the purpose of the exercise was not to provide detailed individual risk, but categorise risk groups, many of the assumptions did not alter the final risk category. For example, a complex major bowel resection in an ASA 3 patient would have a risk of 3.17% if there was a diagnosis of cancer, or 1.65% if there was no diagnosis of cancer. For the purpose of this exercise, both scenarios would require a PACU type bed as the risk was between 1 and 5%. However, if the patient were ASA 2, their risk would be 0.8% with a cancer diagnosis and 0.4% without, so neither situation would necessitate a PACU bed. In the situation where specialties such as ENT/ head and neck surgery were treated as “high risk specialties” (normally limited to thoracic, GI or vascular surgery by SORT), the risk for an ASA 3 patient would be 3.17% treating them as a high-risk specialty, or 1.58% if not high-risk. Defining them as high-risk specialties would be a moot point as both definitions would result in needing a PACU bed. This does assume that the surgery would be complex major

and for cancer, but most surgeries within these specialties that lasts for longer than 2 hours would likely be complex and for cancer by the nature of the specialty. As such, this exercise was considered to give a good approximation of demand and there was agreement amongst the group that this was a reasonable approach to categorising the risk groups, given the information available.

One notable group in this analysis was the breast surgery group. While most cases in this group would have a diagnosis of cancer, most surgeries would not be deemed as complex major by the AXA PPP database and would usually take less than 2 hours. They would also rarely involve the high-risk specialties. As such, despite the cancer diagnosis, they often ended up with a similar risk to orthopaedic surgery. Reconstruction surgery would define them as complex major, but as such surgery usually takes more than 2 hours, this again did not materially affect the numbers once different scenarios were examined.

There was one last group that proved difficult to categorise, which is highlighted in yellow. The ASA 3 group, with surgeries lasting less than 2 hours in the higher risk group could cross the 1% mark in certain circumstances. If the patient was undergoing a hernia repair, this would give a risk of 0.56%. However, if the same patient was undergoing a transurethral resection of a bladder tumour, the risk would be 1.09%. On consideration of these cases, it was felt that in most cases these patients would not be thought to require a PACU bed. Indeed, such cases would often be deemed suitable for day case surgery so, on balance, it was decided not to include this group in our estimations.

Methodology 3 takes many of the same variables and criteria as Methodology 2 however it includes all specialties. Both groups exclude paediatric patients and those patients who do not have a general, regional or spinal anaesthetic.

Will Changes in Population affect PACU Need

Population changes by catchment population will only go some way to determine the capacity required within a PACU. However, as the methodologies are based on the number of surgeries carried out in units, the types of surgery and the service profile of the hospitals, these variables will have a more immediate impact on PACU need in each of the hospitals.

It is also worth noting that not all hospitals carry out all surgeries in Northern Ireland and that many of the complex, regional and tertiary surgeries are centralised onto a few sites. This will mean that population by catchment of each Trust will have less of an impact on services that it would first seem.

It is also fair to say that any recommendations or changes made as part of the General Surgery Review will have an impact on PACU size. Table 10 below shows the population of Northern Ireland by Trust and projected population change to 2027.

Table 10: Population of Northern Ireland

Trust	Trust Population (MYE 2020)	Projected Trust Population 2027	Variance	% Change
Belfast	359752	365261	5509	1.5%
Northern	480751	487681	6930	1.4%
South Eastern	365887	377149	11262	3.1%
Southern	391227	411595	20368	5.2%
Western	304239	305872	1633	0.5%
	1901856	1947558	45702	2.4%

In the context of an aging population with an increased disease burden, it is likely that increasing numbers of high risk procedures will be performed^{xviii}. So age is an important variable in the need for patients to be managed in a PACU. This can be seen if we consider the current elective profile of patients and those within the higher ASA codes. This can be seen in Table 11 below.

Table 11: Elective patients by Age Group and ASA code.

	FY2018/2019	FY2018/2019	FY2019/2020	FY2019/2020
Age	All Asa Codes	For ASA Code 4+	All Asa Codes	For ASA Code 4+
Age <= 65	75.40%	37.41%	74.63%	40.09%
66-80	20.70%	51.70%	21.06%	47.19%
80+	3.89%	10.89%	4.30%	12.72%
Grand Total	100.00%	100.00%	100.00%	100.00%

It is estimated that there will be a 26% increase in the 65+ year olds in the population between 2020 and 2030 it is likely that PACU capacity will need to increase going forward.

Table 12: Population of patients aged 65 + years.

Trust	Trust Population (MYE 2020)	Estimated 2025	% Change 2020 to 2025	2030	% Change 2020 to 2030
Belfast	55542	60208	8.4%	67057	20.7%
Northern	86301	96403	11.7%	108539	25.8%
South Eastern	69998	78869	12.7%	88896	27.0%
Southern	58986	66938	13.5%	77005	30.5%
Western	49824	55958	12.3%	63278	27.0%
	320651	358376	11.8%	404775	26.2%

4. Estimating Demand for PACU

4.1 Methodology 1

Methodology 1 is based on the assumption that between 15-20% of elective patients undergoing surgery are in a high risk category.

The NCEPOD report^{xix}, Knowing the Risk of the Perioperative Care of Surgical Patients looked at patients receiving surgery and identified that around 20% of patients were high risk. While other studies have indicated that 15% of patients can be considered high risk.

During 2018/19 there were 612,895 inpatient and day case admissions to hospital in Northern Ireland. This was an increase of 0.7% (4,317) on the number of admissions during 2017/18 and an increase of 1.1% (6,751) on the number admitted during 2014/15.

Of the 612,895 admissions, 48.1% (295,088) were inpatient admissions and 51.9% (317,807) were day cases.^{xx}

Not all admissions will result in surgery however the majority of elective admissions do result in having a procedure carried out. Information sourced from the Department of Health website would indicate that there were between 40960 and 49642 elective inpatient admissions in Northern Ireland² delivered in an acute setting (Table 13 below) between the years 2016/17 and 2019/20.

While Table 14 below shows the number of day cases carried out. Patients having their procedures at day cases theatres do not meet the criteria of a PACU, and is included to demonstrate the proportion of day case admissions to inpatient admissions. Of note, day case admissions have been reducing over recent years due to a move to patients having minor procedures carried out as outpatient procedures.

Table 13: Elective Inpatient Admissions between 2016/17 and 2020/21

Elective Inpatient					
Row Labels	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Belfast	26490	24080	22585	20353	10582
Northern	4814	4432	4238	3611	1978
South Eastern	5055	4894	5054	4684	2851
Southern	5095	4600	4854	4437	2002
Western	8188	8379	8507	7875	4137
Grand Total	49642	46385	45238	40960	21550

Source : DOH

² COVID years showed a significant drop in elective surgery carried out and as such estimate is based on Acute Use of Operating Theatres historically.

Table 14: Day Case Admissions between 2016/17 and 2020/21

Row Labels	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Belfast	71889	68661	70659	62606	39740
Northern	27157	26258	26494	25905	9021
South Eastern	30902	30643	33250	32574	18406
Southern	33311	32461	35536	32835	15909
Western	31485	31034	32367	30651	19525
Grand Total	194744	189057	198306	184571	102601

Source : DOH

In 2018/19 there were 45,238 inpatient admissions, if we assume that between 15% - 20% of these patients are considered higher risk this would suggest that between 6786 – 9048 patients would benefit being managed in a PACU environment..

The TMS analysis indicates that there were 44,906 Elective patients who had surgery carried out in Main or Emergency Theatres in 2018/19 and a further 25,041 non-elective procedures. This is less than a 1% variation between the two dataset indicating that the TMS dataset has good coverage for inpatient procedures in Acute Hospitals. It should be noted that Musgrave Park is not included in this dataset.

Table 15: TMS Information for 2018/19 and 2019/20 by Age Group (excludes Musgrave Park)

Age Group	FY2018/2019			FY2019/2020		
	Elective	Non Elective	Total	Elective	Non Elective	Total
Age <= 65	32133	17932	50065	28231	17013	45244
66-80	10201	4443	14644	9121	4667	13788
80+	2572	2666	5238	2358	2715	5073
Grand Total	44906	25041	69947	39710	24395	64105

“Acute Data on Use of Theatres” is not available from the Department of Health website for 2018/19, however when we consider in 2017/18 that there were 46,385 elective admissions and 189,057 day cases (Appendix 11 , Table 2) but only 110,777 cases were in theatre this would suggest that there are a significant number of procedures out with theatres (Appendix 11, Table 3: Acute use of Operating theatres by HSC Trust” sourced from the Department of Health). However, the inpatient admissions of around 45,000 are comparative to 2018/19 and 2019/20 information from the TMS system, this would suggest that the biggest variance is

daycases not being carried out in theatres. Using the data from the TMS for inpatient analysis should therefore not be adversely affected.

Taking account of the recommendations of the principles of the national “Guidance on Establishing and Delivering Enhanced Perioperative Care Services” and similar UK models that indicate that PACU is “a time limited intervention, with the expectation that the majority of patients will be discharged from a PACU facility within 12-24 hours, with a small number staying for a maximum of 48-72 hours”. Table 16 below demonstrates that number of PACU beds required in Northern Ireland based on a 50 week model of elective care and operational 5 days per week, likely Monday 1pm to Saturday 1 pm. A further analysis would also need to take account of Musgrave Park Hospital PACU needs.

Table 16: PACU Bed Requirements based on Methodology 1

Trust	Baseline Year : 2018-2019			Regional Bed Need based on 15% risk equation and 50 week year			Regional Bed Need based on 20% risk equation and 50 week year		
	15%	20%		24	36	12 hours	24	36	
				Hour	Hour		Hour	Hour	Hour
Belfast	22585	3388	4517	6.8	13.6	20.3	9.0	18.1	27.1
Northern	4238	636	848	1.3	2.5	3.8	1.7	3.4	5.1
South	5054								
Eastern		758	1011	1.5	3.0	4.5	2.0	4.0	6.1
Southern	4854	728	971	1.5	2.9	4.4	1.9	3.9	5.8
Western	8507	1276	1701	2.6	5.1	7.7	3.4	6.8	10.2
Grand Total	45238	6786	9048	13.6	27.1	40.7	18.1	36.2	54.3

There are a number of issues with using this methodology. The methodology:

- assumes that everyone admitted electively for surgery as an inpatient requires a general or spinal anaesthetic however we are aware that this is not the case. The data from TMS shows that around 20% of patients admitted electively do not have a general, regional or spinal anaesthetic.
- assumes that all specialties would make use of the PACU however it is unlikely all specialties will use the PACU model with medical specialties such General Medicine and Gastroenterology not always requiring anaesthetic or a PACU bed.
- does not take account of patients that would go into ICU following elective surgery.

Findings

Methodology 1 may give us some indication of bed requirements for PACU by Trust but the information is not robust enough to plan bed requirements without a correlation to other information.

4.2 Methodology 2

One of the principle recommendations of NCEPOD was that there “is a need to introduce a UK wide system that allows rapid and easy identification of patients who are at high risk of postoperative mortality and morbidity.”(Departments of Health in England, Wales & Northern Ireland).

The Surgical Outcome Risk Tool (SORT) is a relatively new preoperative tool, having first been described in the British Journal of Surgery in November 2014 (Protopapa et al, 2014). It considers a list of variables which are likely to determine severity of patients and therefore the potential need for management of patients in a PACU or higher setting.

More recent research indicates that combining subjective and objective measurement using the SORT provided an even more accurate estimate. However, it recognises that the sort tool is a useful tool to plan surgical services, including the number of critical care and post-operative enhanced beds required to serve a surgical population.

NCEPOD’s SORT looks at the following variables, SORT2 adds consultant expertise to this information. A further description and explanation of the variables and how these affect patient information on TMS system can be seen on page 18 above in the section outlining the data collection process and assignment of variables.

In summary these are:

Age Group: Age group is split on likely resource need for patients <65 years, 65-79 years old and 80+ years

Surgical Severity : Minor, moderate, major or complex major

Further information regarding surgical severity coding can also be found at <https://online.axapphealthcare.co.uk/SpecialistForms/SpecialistCode.mvc>

High risk Specialties: Thoracic, GI or vascular

Cancer: Active malignancy within past 5 years

ASA-PS scoring: Grades 1-5

Clinical Urgency: based on the NCEPOD classification of intervention (2004)

As outlined above in the data collection section, data was sourced from Northern Ireland’s Theatre Management System databases to test the need for PACU beds based on these variables. While it is recognised that there are data accuracy issues within this data, work was originally out to eradicate as many data issues as possible and standardise the information to make it more user friendly and ensure as

much accuracy as possible. This exercise sought to provide an estimate of the number of patients within certain risk categories.

The “Guidance on Establishing and Delivering Enhanced Perioperative Care Units” recommended that patients with a perioperative risk prediction of > 5% should be admitted to an Intensive Therapy Unit (ITU) postoperatively, those with a risk between 1-5% should be cared for in an Enhanced Perioperative Care (EPC) unit and those with a predicted risk of <1% could be safely managed in a standard ward. The exercise therefore sought to categorise cases from the TMS data into these risk groups using the SORT tool. However, as the full details of individual cases was not available a number of assumptions were made which categorised the information into the most likely scenarios to allow this to be modelled. This is explained further earlier in the document and Table X and Y above. Although this simplifies the situation it does allow an approximation of demand. As the purpose of the exercise was not to provide detailed individual risk, but categorise risk groups, many of the assumptions did not alter the final risk category. Applying these variables provides the following specialty groups on the TMS data.

Table 17: TMS data clustered into procedures groups as defined by SORT variables (excludes all for procedures which were not carried out with General and Spinal Anaesthetics)

Specialty Group	FY2018/2019			FY2019/2020		
	Elective	Non Elective	Total	Elective	Non Elective	Total
Fracture/Orth excluding Musgrave Park Hospital	2463	7721	10184	1856	7524	9380
Intra- Abdominal and Airway	26521	10720	37241	23329	10468	33797
Non Intraabdominal, Airway or Orthopaedic Procedures	6896	2592	9488	6646	2483	9129
Grand Total	35880	21033	56913	31831	20475	52306
Total exc non-intra abdominal & orthopaedic procedures	28984	18441	47425	25185	17992	43177

Further analysis can be seen in Appendix 6 which outlines information by Trust.

The TMS system includes information on age of patient when they received their surgery. If we assume that the PACU is to manage adult patients only. Table x and y considers the number of child <-15 and 16 +. The table indicates that the majority of patients <=15 year old are in the intra-abdominal age group for elective.

Table 18: Patients aged <=15 years old

		FY2018/2019			FY2019/2020		
Spec Group	Sort Score	Elective	Non Elective	Total	Elective	Non Elective	Total
Fracture/Orth exc MPH	<1 %	390	888	1278	288	812	1100
	1-5 –PACU	1		1		1	1
Fracture/Orth exc MPH Total		391	888	1279	288	813	1101
Intra-Abdominal and Airway	<1 %	3680	1382	5062	3403	1244	4647
	1-5 –PACU	61	77	138	42	76	118
Intra- Abdominal and Airway Total		3741	1459	5200	3445	1320	4765
Grand Total		4132	2347	6479	3733	2133	5866

The cases managed within SORT Score 1-5 are likely to include patients managed in PICU – such as scoliosis patients. Table 19 below shows the number of patients that are admitted into PICU for Fracture/ Orthopaedic management or intra-abdominal, and airway management.

Table 19: Patients aged into PICU for fracture / orthopaedic, intra-abdominal or airways management <16 years old

	FY2018/2019			FY2019/2020		
Spec Group1	Elective	Non Elective	Total	Elective	Non Elective	Total
Fracture/Orth exc MPH	35	3	38	20	2	22
Intra- Abdominal and Airway	57	56	113	37	61	98
Grand Total	92	59	151	57	63	120

Data for paediatric patients <=16 years old will be excluded from the information as the management of these patients is unlikely to be in the PACU. It should also be noted that some of these patients are discharged from theatre directly to neonatal or maternity wards and PICU.

Table 20: Patients aged >=16 years old

	FY2018/2019		FY2019/2020	
Spec Group	Elective	Non Elective	Elective	Non Elective
Fracture/Orth exc MPH	2072	6833	1568	6709
Intra- Abdominal and Airway	22780	9257	19884	9146
Grand Total	24852	16090	21452	15855

Table 21 - Intra-abdominal and Airway Specialty Group by Risk Factors

	FY2018/2019			FY2019/2020		
Sort Score	Elective	Non Elective	Total	Elective	Non Elective	Total
<1 %	18639	7321	25960	15999	6946	22945
0.5 – 1 %	1446	396	1842	1258	415	1673
1-5%	2375	1123	3498	2307	1291	3598
>5	320	417	737	320	494	814
Grand Total	22780	9257	32037	19884	9146	29030

Using the ASA Scoring Matrix there were around 2375 elective patients in 2018/19 and 2307 elective patients in 2019/20 are within the risk category 1-5% and would benefit from PACU. A further 1446 elective patients in 2018/19 and 1258 patients in 2019/20 have a risk score of around 1% and potentially could require PACU. Table 22 below shows the comparison to Variable Scoring table that can be seen on page 21, Table 8. It should be noted that of the patients without an assigned ASA code 39 elective patients in 2018/19 and 24 elective patients in 2019/20 have been classified as risk score 1-5% as all other variables meet the criteria. Appendix 6 shows this information by Trust.

Table 22: Intra- abdominal & Airways Elective Patients in 2018/19 and 2019/20 – Methodology 2

ASA Code	Hours	FY2018/2019			FY2019/2020		
		Age <= 65	66-80	80+	Age <= 65	66-80	80+
1	Less than 2 hours	3926	152	9	3014	157	11
	More than 2 hours	808	51	3	639	48	3
2	Less than 2 hours	6394	2356	319	5601	2007	295
	More than 2 hours	2142	813	69	1951	780	88
3	Less than 2 hours	1403	1425	458	1261	1231	438
	More than 2 hours	772	853	185	680	848	176
	Unknown					1	
4+	Less than 2 hours	65	85	32	74	98	50
	More than 2 hours	31	77	26	52	61	33
Unknown but meets other variables	Less than 2 hours	181	66	13	158	55	14
	More than 2 hours	42	21	3	31	27	2
Grand Total		15764	5899	1117	13461	5313	1110

Table 23 – Fractures and Orthopaedics Specialty Group by Risk Factors

Sort Score	FY2018/2019			FY2019/2020		
	Elective	Non Elective	Total	Elective	Non Elective	Total
Sort Score <1 %	1980	5335	7315	1502	5149	6651
SORT Score 1-5 -PACU	92	1498	1590	66	1560	1626
Grand Total	2072	6833	8905	1568	6709	8277

Using the ASA Scoring Matrix there were around 92 elective fracture / orthopaedics patients in 2018/19 and 66 elective patients in 2019/20 are within the risk category 1-5% risk and would benefit from PACU. It should be noted however, that this dataset does not include all orthopaedic patients as Musgrave Park is excluded from the dataset.

Table 24 below shows the comparison to Variable Scoring table that can be seen on page 21, Table 9. It should be noted that of the patients without an assigned ASA

code 4 elective patients in 2018/19 and 1 elective patient in 2019/20 have been classified as risk score 1-5% as all other variables meet the criteria. Appendix 7 shows this information by Trust.

Table 24: Fractures and Ortho Elective Patients in 2018/19 and 2019/20 excluding MPH

ASA Grade	Hours	FY2018/2019			FY2019/2020		
		Age <= 65	66-80	80+	Age <= 65	66-80	80+
1	Less than 2 hours	277	14	1	215	6	
	More than 2 hours	146	16	2	116	5	
1 Total		423	30	3	331	11	
2	Less than 2 hours	363	121	14	281	129	19
	More than 2 hours	326	215	36	216	180	21
2 Total		689	336	50	497	309	40
3	Less than 2 hours	71	88	18	46	53	14
	More than 2 hours	112	159	52	81	109	39
3 Total		183	247	70	127	162	53
4	Less than 2 hours	1	3		2	2	1
	More than 2 hours	4	6	5	3	4	2
4 Total		5	9	5	5	6	3
Unknown but meets other variables	Less than 2 hours	5	4	2	12	2	1
	More than 2 hours	7	2	2	5	4	
Unknown but meets other variables Total		12	6	4	17	6	1
Grand Total		1312	628	132	977	494	97

Methodology 2 would indicate that between 16 – 17% of patients (3913 - 3631 patients) may benefit for management in PACU excluding Musgrave Park orthopaedic patients (Table 25 below).

Table 25: Classification of Sort Score Using Methodology 2 Methodology

Sort Score	FY2018/2019		FY2019/2020	
	Elective	Non Elective	Elective	Non Elective
<1 %	20619	12656	17501	12095
0.5 -1 %	1446	396	1258	415
1-5 %	2467	2621	2373	2851
>5	320	417	320	494
Grand Total	24852	16090	21452	15855

Table 25: Classification of Sort Score Using Methodology 2 for each Trust

Trust	FY2018/2019		FY2019/2020	
	Elective	Non Elective	Elective	Non Elective
Belfast	2050	1255	1973	1430
Northern	273	235	231	247
South Eastern	405	488	408	511
Southern	703	599	608	624
Western	482	440	411	454
Grand Total	3913	3017	3631	3266

Table 26: PACU Bed Calculation by Trust for Methodology 2 – Elective Patients.

Trust	Baseline Year : 2018- 2019	Regional Bed Need based on SORT variables for 50 weeks Mon1pm to Saturday 1pm		
		12 hours	24 Hour	36 Hour
Belfast	2050	4.1	8.2	12.3
Northern	273	0.5	1.1	1.6
South Eastern	405	0.8	1.6	2.4
Southern	703	1.4	2.8	4.2
Western	482	1.0	1.9	2.9
Grand Total	3913	7.8	15.7	23.5

Based on TMS data for 2018/19 and the opening of a PACU for 50 week year from 1pm Monday to 1pm Saturday.

There are a number of issues with using this methodology. Including:

- It assumes that only patients whose procedure can be classified as intra-abdominal, airway or trauma and orthopaedic would benefit from PACU and that no other specialties would benefit from being managed in a PACU setting after surgery. A good example of this is the plastic surgery specialty, which would meet many of the variables required to meet the criteria of benefiting from a PACU, however, because most plastic surgery is not airway, abdominal or vascular related these patients are excluded from the data.
- This methodology does not take account of procedures which may be intra-abdominal, over 2 hours and meeting the severity scoring but where the patients are admitted as an emergency admission rather than an elective admission. Table 27 below shows the number of beds that would be required if the same criteria were applied to emergency admissions. **Note that this will be a significant underestimate as the act that a procedure is anything other than an elective admission is an independent variable in the SORT algorithm.** In general, going from “elective” to “expedited” (requiring surgery in a couple of days) roughly triples the individual risk, going to “urgent” more than quadruples the risk. This will mean many patients will move up a category, so many that would have had a <1% risk may find themselves with a risk between 1-5%, and many with a 1-5% risk would find themselves in the

> 5% risk group. This means many of the patients usually suitable for the ward would end up in PACU and many suitable for PACU would require HDU/ITU. Indeed, this was previously noted that the majority of surgical patients in ITU, outside of the tertiary referral specialties, are emergency patients. To formerly assess the emergency patients would be a full exercise in itself and is planned for the future, but the numbers are included here for purely illustrative purposes to compare the emergency population against the elective. As such these numbers should not form the basis for planning PACU provision at this stage, but may be of interest.

- In the UK a number of procedures are managed in a PACU rather than going back to ward. An example of this would be laparotomy procedures. The group thought that part of the initial bed requirements should allow a percentage of emergency patients to be managed in PACU. Staging the number of PACU beds over time will allow a more robust bed calculation for this need to be determined.
- Further clarity is required if the PACU model would be 24 hours – 36 hours stay

Table 27: PACU Bed Calculation by Trust for Methodology 2- Emergency Patients .

Trust	Baseline Year : 2018-2019	Regional Bed Need Based on SORT variables equation and 50 week year		
		12 hours	24 Hour	36 Hour
Belfast	1255	2.5	5.0	7.5
Northern	235	0.5	0.9	1.4
South Eastern	488	1.0	2.0	2.9
Southern	599	1.2	2.4	3.6
Western	440	0.9	1.8	2.6
Grand Total	3017	6.0	12.1	18.1

Based on TMS data for 2018/19 and the opening of a PACU for 50 week year from 1pm Monday to 1pm Saturday.

Findings

Methodology 2 give us a good indication of the bed requirements for PACU based on TMS patients who meet the inclusion criteria in 2018/19 and 2019/20. However this assumes that only those patients that meet the SORT variable criteria and are either intra-abdominal, airway, fracture or orthopaedic should be considered as benefiting from a PACU.

4.3 Methodology 3:

Methodology 3 is a variation on Methodology 2, it takes all the same criteria applied to the SORT methodology with the exception of the specialty group (intra-abdominal, airway, orthopaedics) and assumes all patients who meet the following criteria may benefit from a PACU:

In summary :

Age Group: Age group is split on likely resource need for patients <65 years, 65-79 years old and 80+ years

Surgical Severity : Minor, moderate, major or complex major

Further information regarding surgical severity coding can also be found at <https://online.axapphealthcare.co.uk/SpecialistForms/SpecialistCode.mvc>

High risk Specialties: All specialties

Cancer: Active malignancy within past 5 years

ASA-PS scoring: Grade 1-5

Clinical Urgency based on the NCEPOD classification of intervention (2004)

Table 28: Classification of Sort Score Using Methodology 3 for each Trust

	FY2018/2019		FY2019/2020	
Trust	Elective	Non Elective	Elective	Non Elective
Belfast	2921	1937	2855	2154
Northern	288	289	241	283
South Eastern	507	599	502	586
Southern	916	769	783	798
Western	657	554	520	579
Grand Total	5289	4148	4901	4400

Please note that the previous caveat mentioned in methodology 2 in regard to non-elective or emergency patients will also apply to these numbers.

Table 29: PACU Bed Calculation by Trust for Methodology 3 – Elective Patients.

Trust	Baseline Year : 2018-2019	Regional Bed Need for Elective Patients based on Methodology 3 for all Specialties- Monday 1pm to Saturday 1pm opening 50 weeks per year		
		12 hours	24 Hour	36 Hour
Belfast	2921	5.8	11.7	17.5
Northern	288	0.6	1.2	1.7
South Eastern	507	1.0	2.0	3.0
Southern	916	1.8	3.7	5.5
Western	657	1.3	2.6	3.9
Grand Total	5289	10.6	21.2	31.7

Based on TMS data for 2018/19 and the opening of a PACU for 50 week year from 1pm Monday to 1pm Saturday.

Table 30: PACU Bed Calculation by Trust for Methodology 3 – Emergency Patients.

Trust	Baseline Year : 2018-2019	Regional Bed Need for Emergency Patients based on Methodology 3 for all Specialties- Monday 1pm to Saturday 1pm opening 50 weeks per year		
		12 hours	24 Hour	36 Hour
Belfast	1937	3.9	7.7	11.6
Northern	289	0.6	1.2	1.7
South Eastern	599	1.2	2.4	3.6
Southern	769	1.5	3.1	4.6
Western	554	1.1	2.2	3.3
Grand Total	4148	8.3	16.6	24.9

Based on TMS data for 2018/19 and the opening of a PACU for 50 week year from 1pm Monday to 1pm Saturday.

Findings

Methodology 3 give us a good indication of the bed requirements for PACU based on TMS patients, for all specialties who meet the inclusion criteria in 2018/19 and 2019/20. However it is unlikely that all surgical patients will benefit from a PACU bed and as such the estimates are likely to higher than required.

It is most likely that the PACU bed needs will be between Methodology 2 and 3.

5. Workforce

Dr Oliver Boney et al in their paper Raising the Standards: RCoA quality improvement compendium outlines what RCOA believes the workforce needs are for a PACU^{xxi}.

Best practice

Hours of operation

Recommendations from the Association of Anaesthetists state that the PACU must have sufficient numbers of trained staff available throughout all operating hours, and if an emergency surgical service is run the PACU must remain open 24 hours a day.

Staffing levels

No fewer than two nurses should be present if one patient is in the PACU. Any patient unable to maintain their own airway must be nursed continuously on a one to one basis by a nurse who has no other duties. Staffing should be sufficient to meet this requirement even in peak periods.

Competencies required

All PACU staff should have been trained in and deemed to have achieved locally or nationally agreed prescribed competencies.

Monitoring

Monitoring is required until the patient has fully recovered from anaesthesia and as a minimum should include clinical observation supplemented by pulse oximetry, non-invasive blood pressure and temperature monitoring. An electrocardiogram (ECG), nerve stimulator, capnography and glucometer must be immediately available should they be needed.

Depending on the local surgical case mix, some PACUs may additionally consider immediate access to near patient testing (eg arterial blood gas, HemoCue or point-of-care coagulation testing) a desirable standard of care.

Record keeping

All patients should have regular observations documented until PACU discharge.

Staffing

- Staffing in the PACU should be trained to the recognised standard, audited at different times of day and night.
- PACU staffing should be available out of hours particularly if PACU is used for emergency admissions.

- PACU should be closed to new admissions when inadequate staffing levels are available.
- There should be monitoring in place to understand underlying reasons for inadequate staffing levels, or inadequately trained PACU staff.

At the meeting on the 21 December 2021 Dr McCormick and Catriona McGarvey presented the findings from the pilot that took place in the BCH. This outlined learning from the pilot on staffing in BCH. The presentation can be seen in Appendix 2.

It recognised that although PACU needs its own staffing, some of the staffing required will and should move between PACU, recovery and theatres for the most efficient and effective means. The tables below outline the staffing need for medical, nursing and other staffing to manage a 4 bedded PACU.

Table 31: Medical Team required for 4 PACU Beds

Medical Lead	Responsible for:
Consultant Surgeon Specialty lead	Daily review of surgical patient and first point of contact for all surgical matters such as feeding/ drain management/ suspected haemorrhage/ suspected intra-abdominal pathology. OOH including BH/PH & weekends on call surgical team or a delegated colleague. Case load factored into normal working day as surgical team follow patient not the location.
Surgical Registrar / Trainee	As above
Resident Consultant Anaesthetist – Duty Consultant	Responsible for any postoperative anaesthetic issues such as analgesia, respiratory support, cardiovascular support or renal support (M-F 0800-1800) Daily PACU ward round led by the Duty Consultant on normal weekdays Duty Consultant – 1.25pa
Duty 2 anaesthetic registrar	Responsible for covering OOH including BH/PH and weekends. On call anaesthetic consultant available for escalation.
PACU speciality Lead	PACU & pre op assessment – 0.75pa

Table 35: Other staffing required for PACU 4 bedded Unit

Physiotherapy	B7 0.5wte - elective reviews twice daily, early mobilization day zero, accessible via bleep 8:30-16:30 and OOH on call availability for emergency chest physiotherapy.
Pharmacist	GPICs guidelines state 0.1 wte per 2 beds therefore for PACU/recovery model combined, 0.6wte B7 required to cover 10-12beds
Porters	Band 2 Based in close proximity to unit to facilitate transport of patients discharged to ward after PACU stay.

Suggested Staff-patient ratios monitoring

ROCA also outline that staffing levels should be monitored for safety and governance and suggest the following monitoring requirements.

- Percentage of patients recovering from spinal, epidural or general anaesthesia who are cared for in a specifically designated recovery area with sufficient numbers of adequately trained staff.
- Percentage of unconscious patients who are being cared for on a one to one basis.
- Percentage of conscious patients requiring critical care or critical care monitoring who are being cared for in a ratio of one nurse to two patients.
- Percentage of conscious stable patients who are being cared for by nurses not involved with the patients above (eg patients ready for discharge awaiting transfer to the ward).
- Percentage of patients with an advanced airway in place who have continuous capnography monitoring.
- Percentage of patients having their observations recorded with appropriate frequency.
- Percentage of patients monitored with non-invasive blood pressure, pulse oximetry and temperature.
- Ease and speed of applying further monitoring such as capnography, ECG or nerve stimulator.
- Ease and speed of obtaining ABG, blood glucose, HemoCue or point-of-care coagulation results.

- Percentage of patients with complete documentation of observations from PACU arrival until discharge.
- Reasons for inadequate monitoring or delay in applying additional monitoring when required (eg shortage of monitoring devices, monitoring device broken/not charged/being used elsewhere).

Findings

Table 2 below is the staffing required for Phase 1 of the PACU beds by Trust and the group recommended securing the staffing for these beds as soon as is possible to allow PACU beds to open.

With regard to nurse and AHP staffing, the Workstream recommended that staff receive the right training and competencies in order to take forward the role, this could be achieved through local development at each of the Trusts however these competencies and skills will need to be standardised regionally and the Public Health Agency, Director of Nursing could be asked to work with Trusts to do this.

It is also recommended that Job Descriptions for the posts should be taken forward as part of the Implementation Group and for nurse staffing as part of the Delivering Care for Theatres and Recovery.

The Pharmacy Group should be asked to take forward a Job Description for Pharmacists.

Table 2: Phase 1 Staffing Workforce

Trust	Hospital	PHA Beds Phase 1	Nurse Staffing RN	Nurse Staffing HCA	Physiotherapist	Pharmacists
Belfast Trust	Belfast City Hospital	4	7.94	3.96	0.5	0.25
	Royal Victoria Hospital	4	7.94	3.96	0.5	0.25
	Mater Hospital					
Northern Trust	Antrim Hospital	3	5.96	2.97	0.38	0.19
	Causeway*					
Southern Trust	Craigavon	3	5.96	2.97	0.38	0.19
South Eastern	Ulster Hospital	4	7.94	3.96	0.5	0.25
Western Trust	Altnagelvin	3	5.96	2.97	0.38	0.19
	SWAH*					
Total		21	41.685	20.79	2.625	1.3125

Appendices

Appendix 1: Terms of Reference

Appendix 2a: Presentation of PACU Pilot in BCH to PACU Workstream - Dec 2021

Appendix 2b: Presentation of PACU Workforce from BCH PACU Pilot to PACU Workstream – Jan 2022

Appendix 3: Understanding the Data for Methodology 1,2 and 3

Appendix 4: Standard Operation Procedure based on Sample BCH SOP and Protocol for Admission

Appendix 5: SORT Analysis Assumption

Appendix 5A: Sort Criteria by Trust

Appendix 6: Intra-Abdominal and Airway Analysis by Trust – Methodology 2

Appendix 7: Trauma and Orthopaedic Analysis by Trust (excluding Musgrave Park) – Methodology 2

Appendix 8: Activity by Trust -Methodology 3

References

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- ⁱ Model of Care for Elective Surgery. National Clinical Programme for Surgery. HSE, Royal College of Surgeons in Ireland, College of Anaesthetists of Ireland.
- ⁱⁱ <https://www.ficm.ac.uk/standardssafetyguidelinescriticalfutures/enhanced-perioperative-care>
- ⁱⁱⁱ [Assessment of staffing and service provision in the PACU | DHPS \(dovepress.com\)](#)
- ^{iv} Simpson and Moonesinghe Perioperative Medicine .
- ^v Northern Ireland Action Plan for Surgical Recovery 10 steps not 10 years. Royal College of Surgeons of England.
- ^{vi} The Royal College of Anaesthetists (RCoA) shared its vision for the future of perioperative healthcare provision across the UK. Speaking at a stakeholder event, President of the RCoA Dr J-P van Besouw said: "With more than ten million patients undergoing surgery each year in the NHS, approximately 15% of whom are deemed to be high-risk, a care pathway that can harness multi-disciplinary working, reduce variation and improve patient outcomes must be our goal."
- ^{vii} https://www.researchgate.net/publication/7032893_Identification_of_the_high-risk_surgical_population_in_the_United_Kingdom.
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- ^x [NCEPOD - Peri-operative Care: Knowing the Risk Report \(2011\)](#)
- ^{xi} [Overview | Routine preoperative tests for elective surgery | Guidance | NICE](#)
- ^{xii} Development and validation of the Surgical Outcome Risk Tool (SORT), [K. L. Protopapa, J. C; Simpson, N. C. E. Smith, S. R. Moonesinghe](#), *BMJ*, **Volume101, Issue13**, December 2014, Pages 1774-1783
- ^{xiii} Is there a place for the Surgical Outcome Risk Tool app in routine clinical practice?, Karen Protopapa, NCEPOD, *British Journal of Hospital Medicine* , November 2016, volume 77, No 11
- ^{xiv} Guidance on Establishing and Delivering Enhanced Perioperative Care Services, October 2020, The Faculty of Intensive Care Medicine and Centre for Perioperative Care. <https://www.ficm.ac.uk/standardssafetyguidelinescriticalfutures/enhanced-perioperative-care>
- ^{xv} [21075 RCoA Audit Recipe Book 12 Section B.3 p131-154 AW.pdf](#)
- ^{xvi} [Perioperative care in adults \(nice.org.uk\)](#)
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- ^{xviii} Wilkinson k, Martin IC, Gough MJ, Stewart JAD, Lucas SB, Freeth H, Bull B, Mason M: An age Old Problem: A review of the Care of the Elderly Patient Undergoing Surgery. London NCEPOD; 2010
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- ^{xx} [Publication of 'Northern Ireland Hospital Statistics: Inpatient, Day Case and Outpatient Activity Statistics \(2018/19\) | Department of Health \(health-ni.gov.uk\)](#)
- ^{xxi} Boney O, Trundel S, Peri-operative Care, www.ROAC.ac.uk Fourth Edition September 2020