Great Ormond Street Hospital for Children
NHS Foundation Trust

Medical Director's Office
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Wednesday, 27 November 2019

Private & Confidential

Mr Edwin Buckett
Assistant Coroner
Inner North London
St Pancras Coroner's Court

Dear Sir

Following receipt of your regulation 28 Prevention of Future Death Report, Great Ormond Street Hospital NHS Foundation Trust (the Trust) convened a working group of senior clinical staff to identify and implement the necessary actions to ensure that patients like Amy are cared for in the safest possible way in future.

The actions of the Trust are primarily focussed on improving the pathway that Amy experienced at GOSH, specifically the spinal surgery pathway with intensive care and ECMO support. The Trust has also evaluated how the lessons learned from Amy's care are shared throughout the hospital particularly in terms of improvements to the surgical pathways for other complex and high risk patients. The Trust recognises that these actions will not change what happened to Amy, but it hopes that these actions will give her family some comfort and reassurance that the Trust has learnt from Amy's case and continues to do so to ensure that that all patients at the Trust receive the highest standard of care.

These actions which the Trust has taken, and those actions which are currently in progress have been summarised below in response to the specific concerns which have been raised.

(a) It appears that there is a lack of awareness and sharing of information between departments at Great Ormond Street Hospital. In particular, the PICU had not been given any advance warning of Amy's complex medical background and needs before she was admitted there post operation. As PICU staff were not invited to the MDT meetings prior to the operation, they were not aware of the 'critical time' which lay ahead for her

The Trust recognises that it is crucial to have processes in place to ensure that all relevant members of the multi-disciplinary team (MDT) are part of the decision making processes for complex patients. There are many different MDT meetings which take place in the Trust to enable this to happen, including a spinal MDT meeting. This monthly spinal MDT meeting is designed to ensure that all elective spinal admissions are managed safely and that information is shared accordingly with all relevant teams. It was clear from Amy's case that the spinal MDT meetings had not achieved this for her. The spinal MDT meetings took place without the involvement of all necessary participants, and the outcomes of that MDT were not effectively disseminated to all the necessary personnel following the meeting.

The PICU Consultant is an important member of the spinal MDT meeting as many of the spinal patients are initially cared for on PICU post operatively. When Amy's case was discussed at the spinal MDT meetings, the PICU consultant was not present. Although routinely invited to the monthly spinal MDT meeting, and were specifically invited to both of the spinal MDTs at which Amy was discussed, the PICU consultant was unable to attend. The Terms of Reference (TOR) for the MDT have now been amended to mandate the need for the attendance of the identified PICU consultant who acts as liaison with the Spinal Team. The TOR also now reflects the responsibility of the PICU consultant to arrange appropriate PICU consultant level cover for the spinal MDT meeting in the event that they are unable to attend. The same requirement has been applied to all of the additional specialties who are required to attend the spinal MDT meeting. The TOR also specifies that it is the responsibility of the MDT Chair to ensure that all relevant specialties are present for the discussion of each case. If there is no representative present then the patient will not be discussed. If there is a pressing clinical need then a further meeting involving all required clinicians before the next monthly spinal MDT meeting will be convened by the Chair of the spinal MDT. A copy of the TOR is enclosed with this response.

The minutes of the spinal MDT meetings which discussed Amy's care were not circulated to the PICU team. The attendance of the relevant individual (in this case, the PICU Consultant) at the MDT meeting is best practice to facilitate appropriate conversation, and the circulation of the minutes provides additional opportunities for other members of the broader clinical teams to understand the needs of patients who may be admitted under their care. At the time Amy's care was discussed at the spinal MDT meetings, the notes of the meeting were typed up and generally circulated via email. However, the notes of the MDT meetings at which Amy was discussed were not circulated to the PICU Consultants.

In April 2019 the Trust launched a new electronic patient record system (Epic) that replaces the previous paper records and combines numerous existing electronic systems. Epic now enables the notes of MDT meetings to be recorded directly within the individual patient's records. It is therefore much easier for all teams involved in caring for a patient to access the outcome of the MDT discussions. Epic also includes a messaging system (similar to email) within the patient's records to support clinicians discussing the patient's care and to ensure that those messages are directly linked to the patient's records. This provides a much better awareness and sharing of information between departments.

In addition to the safety improvements which Epic brings, the Trust has made a number of changes to ensure that the outcome of the spinal MDT meeting are effectively communicated. This includes:

- Flagging high risk patients on the electronic PICU booking form;
- Requiring the PICU consultant who attended the spinal MDT to brief the PICU team on any elective spinal admissions to PICU as part of their weekly consultant meeting;
- Requiring the spinal CNS to send an email reminder to the PICU consultants regarding high risk spinal patients a week before admission and on the day of admission to ensure that the consultant who is in charge of the unit on the day of admission is aware of the known risks;
- Requiring the PICU consultant in charge of the unit on the day of admission to discuss the planned admissions for the day after the morning ward round to update themselves and the team about any known risks.

The Trust believes that these requirements ensure the PICU consultant in charge, on any given day, is appropriately aware of high risk patients admitted to the intensive care unit. Further work is also underway to develop enhanced electronic Patient Status Boards within Epic. The boards will include

an overview of all patients on the unit (or those due to be admitted imminently). It will provide key clinical information, including high risk status, on one screen. This work is being supported by the Electronic Patient Record team and is already underway. It is anticipated that these boards will be in use from January 2020.

In addition to strengthening the pathways for spinal patients with complex co-morbidities, the Trust has also reviewed how it can apply the learning from Amy's case to other surgical pathways. As a result two significant projects are now underway:

- Expanding the provision of Anaesthetic Pre-Operative Assessment (APOA) to all GOSH patients undergoing an elective intervention under general anaesthetic
  - This service triages patients according to their level of risk into an appropriate pre-operative appointment with the anaesthetic team (i.e. telephone appointment, face to face with nurse or face to face with anaesthetist). Risk is determined based on a number of factors including; comorbidity, complexity of intervention and assessment of risk at triage;
  - This triage will identify those particularly high risk patients for whom a Complex Patient MDT meeting should be organised. This would include the need for cardiac and PICU Consultant, and other relevant specialties, to attend. This Complex Patient MDT would determine the peri-operative plan and post-operative location for the patient.
  - The APOA service is not currently used by all specialities within the Trust, as much of the pre-operative assessment process is managed at specialty level by the Clinical Nurse Specialist (CNS) who supports the surgical teams;
  - Referrals will be made to the Joint Cardiac Conference (JCC) as required by the cardiac representative at this Complex Patient MDT. In cases where ECMO is identified as a possibility, there will be cardiac intensive care team involvement in the consent process.
  - The expansion of this service will be phased to allow necessary recruitment into the APOA service. The first phase of expansion is planned to take place in January 2020. The Trust expects to be in a position to mandate the requirement for all patients undergoing an intervention under GA to be triaged by APOA within 9-12 months, namely by November 2020. The implementation progress will be tracked through the Patient Safety and Outcomes Committee.

- Improving the governance of MDT meetings
  - Amy's journey demonstrated how important it is that the Trust has good governance arrangements in place for all MDT meetings to ensure that all relevant clinicians are in attendance; that meetings are appropriately documented and the information disseminated effectively to the right staff; and that all actions arising from MDTs are completed;
  - A consultant surgeon has been identified by the Medical Director to lead a project to guide best practice in conducting MDTs across the Trust. This began in October 2019;
  - Trust wide requirements for MDT attendance and documentation have now been agreed. The requirements will shared with the Operational Board on the 11th December 2019 for dissemination to operational clinical teams to action.
  - A baseline audit of current MDT performance began in November 2019 and the results will be reviewed at our Patient Safety and Outcomes Committee to support Trust -wide improvement. The results of this audit are due to be discussed at the December 2019 meeting.
  - An annual audit has been agreed to ensure that the Trust has assurance that the MDTs are working effectively to provide the safest care to our patients. The frequency of the audits may increase depending on the results of the audit

The learning from Amy's case, and the Trust-wide changes we have made as a result will be discussed at the Surgical Forum on the 13th December 2019. This forum brings together all of the Consultant Surgeons at the Trust to facilitate discussion and cross-specialty learning. The Trust thinks that sharing Amy's story in this way will ensure that the surgical teams understand the importance of the changes to our systems and processes.

(b) There was no clear plan or instruction for the management of Amy post operation in relation to extubation and ECMO support on the PICU

The Spinal MDT TOR have been amended to include the specific responsibilities for clinicians attending the meeting in regards to ECMO. This is reiterated in the PICU guidance for managing spinal patients. A copy of this guidance is enclosed [Spinal Surgery Pathway PICU FINAL].

The new agreed process is as follows:

- If a patient discussed at the spinal MDT is identified as potentially requiring ECMO support post-operatively, their case will be referred to the Joint Cardiac Conference (JCC) by the Cardiologist present at the Spinal MDT (or by another appropriately briefed cardiology consultant);
- The JCC will review the case and determine whether ECMO support post- operatively is appropriate;
- If the JCC consider that pulmonary hypertension, or another cardiorespiratory condition, is a significant issue and ECMO is being considered, then the JCC will identify the safest environment for the patient's post-operative care (Cardiac Intensive Care Unit or Paediatric Intensive Care Unit) in light of the patient's overall condition.
- The JCC will also confirm who will participate in the joint consent process with spinal surgeon to ensure that the patient and family receive appropriate patient information and counselling during the consent process;
- The cardiologist linked to the spinal MDT will share the outcome of the JCC with the spinal team (either via the next spinal MDT or through the Spinal Consultant or the spinal CNS team if the case is more clinically urgent). This information will also be recorded as the outcome of the JCC MDT discussion in the patient record on Epic so that the post-operative management plan for ECMO is available to all staff caring for the patient;
- On the day of the operation, the consultant anaesthetist will contact the ECMO team to confirm that there is ECMO capacity as well as ICU bed capacity.
- Following the post-operative evening ward round on PICU/CICU, there will be a formal discussion between the PICU Consultant, CICU Consultant and the Perfusionist-on-call regarding the high risk patients on both units, so that all relevant team members are briefed on the patient's condition ahead of the night shift.

The plans and instructions for management of extubation are guided by the patient's consultant anaesthetist on the basis of the patient's response to the general anaesthetic on the day of the procedure. This means that the handover between the anaesthetic and PICU team is a crucial safety mechanism. The changes which the Trust has made in relation to the anaesthetic-PICU handover are outlined in paragraph (c).

The plans for extubation may evolve over the course of the patient's post-operative course for several different reasons and the PICU Consultant is responsible for making decisions based on the patient's

clinical condition once the patient is on PICU. The PICU Consultant is also responsible for ensuring that the plan is clearly articulated, documented and understood by the clinical team supporting delivery of care in PICU. We undertake twice yearly documentation audits on PICU in line with the NHS 7 day service reporting requirements. This includes evaluation of consultant review documentation at least twice daily. The audit was most recently completed in October 2019 and the outcome was presented to the Patient Safety Outcomes Committee in November 2019. The results identified the need for additional computers on the unit to ensure that all documentation can be completed in a timely way. Additional computers were received on the unit in November 2019.

(c) The handover between clinicians involved in Amy's operation and those taking over her care in the PICU, was poorly executed with vital information either not properly conveyed or recorded or simply missed.

The Electronic Patient Record department is currently supporting the Anaesthetic and ICU teams to develop a standardised electronic handover document which mirrors the paper form which has been developed for this purpose. The electronic handover document will ensure that all the relevant fields are together in one section so that they can be clearly and easily discussed as part of a structure verbal handover, and act as an ongoing plan to support the ICU team.

The electronic handover is currently being tested by the Electronic Patient Record team to ensure that it provides a secure platform for the anaesthetic and intensive care teams. This is expected to be completed by February 2020. This will be accompanied by an appropriate training programme to standardise handover between the two specialties to ensure that both the correct information required is available and the personnel who need to be present to receive it are in attendance. The lessons we have learned from Amy's care will be incorporated in this training. The Trust expects to launch the new electronic handover in February 2020. In the interim, the anaesthetic and ICU teams will continue to use the paper form (which will then be scanned onto the Epic system).

The Trust expects this handover to take place between the Anaesthetic Consultant and the PICU Consultant whenever possible. The Clinical Lead for PICU and the Clinical Lead for Anaesthetics have reminded all Consultants of this requirement again in November 2019. When it is not possible (e.g. PICU Consultant is busy with another patient), handover should be given to the most senior doctor on the unit, who will then share that information, alongside the handover document, with the PICU Consultant. Where further discussions about the patient between the Anaesthetic Consultant and the PICU Consultant are required, these are now recorded in Epic. It is the responsibility of the PICU Consultant to record this information.

(d) There was a delay in commencing ECMO support

ECMO is an invasive therapy that may sustain life where the natural history of the underlying condition is understood or modifiable. The Trust is commissioned to provide ECMO support for post-operative cardiac patients and respiratory patients in the South East of England. These children are generally either:

(i) known to the cardiac team; or
(ii) referred with circulatory and/ or respiratory failure that is refractory to conventional intensive care therapy

Patients being considered for ECMO commonly have life threatening physiological signs and metabolic disturbance consistent with failure to respond to conventional intensive care therapy. Once a patient is receiving ECMO, the underlying conditions may improve with supportive measures (eg resting the heart after heart surgery or cessation of aggressive ventilation with influenza) or specific treatments (e.g. further surgery or antibiotics). With increased complexity, including chronic multi-system or life limiting conditions, the balance of risk and benefit becomes less clear, and the clinical outcomes become uncertain.

The Trust does not standardly provide rescue extra corporeal life support (ECLS) for all other patients who may collapse within the Trust. However, the Trust aims to provide ECLS wherever possible to patients who are likely to gain benefit. The decision to deploy ECLS routinely includes:

1. an assessment of response to escalation of medical therapy coupled with;
2. discussions with the treating team and family regarding anticipated outcomes, whilst;
3. assembling the team and planning for a surgical cannulation procedure.

There are inherent delays in this approach and there are no local, national or international timescales for ECMO cannulation. Whilst the ECMO team always works hard to avoid unnecessary delays, it is recognised that it is not always possible to get this judgement right and they err on the side of safety. Often transferring a critically ill patient to Great Ormond Street for ECMO or assembling the ECMO team does not culminate in cannulation for ECMO because it has been possible to stabilise the patient with conventional ICU therapy. In that situation the ECMO team is retained 'on standby' in case of deterioration.

When Amy was on PICU the clinical need for ECMO was identified at approximately 3am on 5th September 2018. The Cardiac Intensive Care Consultant was contacted by the PICU Consultant and they confirmed at approximately 3.30am that the ECMO team was being assembled and this would take approximately 45 minutes. The PICU Consultant wanted the ECMO team for support in the event of a cardiac arrest during intubation. Amy's clinical condition deteriorated significantly (with systolic blood pressure below 60mmHg accompanied with a drop in her level of consciousness) and this necessitated re-intubation ahead of the ECMO team arrival. The ECMO team were onsite just after 4am as Amy was being intubated. Amy tolerated re-intubation and showed some initial signs of improvement with an echocardiogram showing improvement in the function of the right side of her heart. While the ECMO circuits were being prepared by the ECMO team, the PICU team tried various conventional management strategies (including vasopressin, sodium bicarbonate, magnesium and a blood transfusion) to see if ECMO could be avoided. Initially there were some improvements in Amy's condition, so the decision to cannulate was delayed. However, there was no significant clinical improvement overall and therefore the clinical decision to put Amy on ECMO was taken at approximately 7.15am and ECMO cannulation began. She was cannulated and started on ECMO at 8.30am.

In order to put patients on ECMO, a team of experienced professionals is required. The majority of staff groups required as part of the ECMO team are part of other 24/7 rotas. However, we do not have a resident on-call perfusion service 24/7, as the need for unanticipated rescue ECLS out of hours is rare. The Perfusion team (specialists that routinely manage patients on heart-lung bypass circuits) have an important role in decisions regarding the mode of ECMO, size of cannula and physical site of cannulation in addition to an active involvement during the cannulation process. However, outside their contracted hours, the on-call perfusionists may not be on site unless a patient at risk of decompensation has been highlighted or an emergency bypass surgery (such as a transplant) is being

undertaken. If the perfusionists are required to stay on site, they are provided with appropriate rest facilities. If there is an emergency involving a patient not known to the ECMO team (including patients who may be transferred in from other hospitals), but one for whom it is agreed that ECLS would be in their best interests, then the team are called in from home. This is similar to arrangements for out of hours theatre cases.

The new agreed process for the identification of patients like Amy (articulated above) ensures that:

- there is a more robust pathway for involving the members of the cardiac and ECMO team in pre-operative preparation via the JCC meeting;
- that patients and families have a better understanding of what ECMO entails and how the process will work;
- that the PICU consultant on the day of admission has a clear understanding of any patient who has been identified as potentially requiring ECMO;
- there is a pre-operative check by the anaesthetist to confirm ECLS capacity on the morning of the procedure; and
- it ensures that the perfusion team are able to identify when they need to stay on site as part of their on-call.

(e) No single properly informed clinician appeared to be coordinating Amy's post-operative care in such a complex and high risk case.

The nature of caring for complex surgical patients means that there will be several clinicians involved in their care. This also means there will be different individual clinicians responsible for and coordinating care at different points in their surgical pathway according to their clinical expertise. In Amy's case the individuals were: the Consultant Spinal Surgeon, Consultant Anaesthetist and the Consultant Intensivist. Effective communication and handover between the teams are crucial in providing safe care. Below is a table of showing the surgical pathway that details the responsibilities of a particular clinical speciality at each stage of the pathway:

Surgical Pathway Stage	Person responsible for care
Pre-operative assessment - Including arranging quorate MDT decision making	Spinal Consultant
Bed booking - Including flagging of high risk patients on the booking forms - Including email reminder to PICU Consultants one week before admission and on the day of admission	Spinal Consultant - Undertaken by the Spinal CNS on their behalf.
Pre-operative admission management	Spinal Consultant
Intra-operative management	Jointly managed by Spinal Consultant and Anaesthetic Consultant
Handover to PICU	Anaesthetic Consultant to PICU Consultant
Immediate post-operative care	PICU Consultant
Ongoing post-operative care following discharge from PICU	Spinal Consultant

To ensure that all staff members involved in the care are clear about the pathway, and their roles and responsibilities within that pathway, the PICU Consultant Team have now also developed a guideline on the spinal surgery pathway for complex cardiac patients admitted to PICU. A copy of this guideline is enclosed [Spinal Surgery Pathway PICU FINAL].

The PICU Consultant had responsibility for Amy's post-operative care following transfer to the unit. The Trust operates a closed intensive care model. A closed intensive care model is when the responsibility for decision making is taken by the intensive care unit consultants. This is done in collaboration with other specialists, including the surgeons and anaesthetists, but the intensivists are the decision makers and they direct care for the patients whilst they remain on ICU. The ICU is staffed with intensivists directly responsible for care.

An open unit model is when each specialist (e.g. a surgical consultant) is responsible for directing the care of their patients whilst on ICU; these specialists are not intensivists.

The PICU at Great Ormond Street Hospital is a closed unit so responsibility for care of patients whilst they are on the ICU is that of the intensive care consultants.

Research has demonstrated the evidence of better outcomes for patients on a closed versus an open ICU.

- Provonost, JAMA 2002: High intensity versus low intensity ICU physician staffing is associated with reduced hospital and ICU mortality and ICU length of stay.
- Treggiani, AJRCCM 2007: In a cohort study of patients with acute lung injury, admission to a closed model of intensive care unit was associated with reduced mortality independently of patients' characteristics. These findings support recommendations to implement closed model intensive care units.
- El-Kersh, Am J Infect Control 2016: Infectious complications in the intensive care unit (ICU) are associated with higher morbidity, mortality, and increased health care use. Reported results of implementing 2 different models (open vs closed) on infectious complications in the ICU. The closed ICU model was associated with 52% reduction in ventilator-associated pneumonia rate (P = .038) and 25% reduction in central line-associated bloodstream infection rate (P = .631). We speculate that a closed ICU model allows clinical leadership centralization that further facilitates standardized care delivery that translates into fewer infectious complications.
- Wilcox E, CCM 2013: Meta-analysis of 52 studies demonstrating that high intensity intensivist staffing reduces ICU and hospital mortality in critically ill patients.
- Core Standards for Intensive Care Units 2013, Faculty of Intensive Care Medicine, UK

The closed unit structure clearly defines which single clinician is responsible for care. In Amy's case, our systems and processes failed to provide that PICU Consultant with all of the information they needed, and at the time they needed it, to deliver the care that Amy required. The changes that the Trust has outlined in the preceding paragraphs (MDT meeting management; MDT documentation on Epic; PICU high risk patient booking forms; PICU consultant meetings; weekly and on admission email reminders to PICU consultants; PICU patient summary review on the morning of admission; and anaesthetic consultant to PICU consultant handover) set out the way in which the PICU Consultant now receives that information, as well as the work the Trust undertaking to improve and refine this further.

Monitoring of ongoing actions

The Trust, and all of those staff involved in Amy's care, are very sorry for what has happened. The Trust recognises that there were failings in our systems and processes to protect Amy, and the Trust is committed to ensuring that there is lasting organisational change as a result. These changes will impact the spinal surgical pathway, and will also impact the pathways of all complex patients undergoing general anaesthetic at the hospital. There is a diagram enclosed with this response [*Pathway Comparison*] which aims to show how the pathway for high risk spinal patients like Amy is different now, as a result of the lessons we have learned from her care.

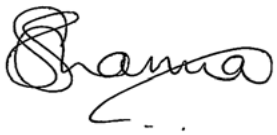
The actions outlined in this document will be scrutinised through our internal governance processes including:

- Monthly detailed review of ongoing actions through Closing the Loop meeting (Chair: Medical Director);
- Update on overall progress, and results of associated audits will be completed by the Patient Safety and Outcomes Committee (Chair: Medical Director);
- Assurance on the completion and impact of the actions taken will be provided quarterly to the Quality Safety and Experience Committee (Chair: Non-Executive Director);
- External scrutiny will be undertaken by NHS England and the Care Quality Commission.

NHS England will be updated on progress with the action plan through monthly Clinical Quality Review Group meetings. The Care Quality Commission will be updated regularly as part of relationship management meetings.

The Trust would also be willing to provide Amy's family with regular updates (either directly or through their solicitors) on the progress that has been made, if they would find that beneficial.

Yours Sincerely



Dr Sanjiv Sharma

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[redacted]

Terms of Reference
Spinal Service Multidisciplinary Team Meeting

1 Purpose

The Spinal MDT meeting (SMDT) is responsible for co-ordinating a cross speciality approach to agreeing each complex patient's continuation to a Spinal Surgical intervention. Its scope includes all patients on the waiting list for spinal surgery identified as complex and requiring review and individualised plan of care.

From September 2019 the SMDT will include a spinal M+M and present results of audits undertaken by the spinal team. This meeting will be held from 08:00 – 12:00.

2. Objectives

The objective of SMDT is;

- To ensure multi-speciality agreement on patients who should proceed to surgical intervention.
- To ensure complex patient have a full systems review prior to surgical intervention.
- To ensure patients identified as complex have an individualised plan of care for the duration of their patient journey up to and including a safe discharge.
- To ensure all departments involved in the patient's journey have access to the individualised plan of care.
- To ensure that patients receive all levels of inpatient care in designated areas which have the resources required to provide the level of care needed.
- To continue to reduce length of stay within the division.
- To improve the safety and standards of patient care within the division.
- To improve the patient and family experience within the division.

3 Core Membership and Responsibilities

The SMDT core membership is multi-disciplinary with representation from professionals across the care pathway. All core members are required to regularly attend the SMDT meetings and activity engage and support the delivery of the SMDTs purpose and objectives.

For a quorum, the following core members must attend:

1. Two consultant surgeons (where one consultant is on annual leave, they must provide comments prior to the meeting. Comments must be received by the Clinical Nurse Specialist (CNS) Team/Advanced Nurse Practitioner (ANP) by 2pm on the Friday preceding the meeting)

2. Cardiology Consultant

3. Respiratory Consultant

4. Anaesthetic Consultant

5. General Paediatrician (Consultant)

6. Paediatric Intensive Care Consultant

7. Spinal Clinical Nurse Specialist (CNS)

8. Spinal Fellow (if not available a second CNS to present the x-rays and MRI's)

9. Physiotherapist

10. Occupational Therapist

11. Administrator (taking list of attendees)

Others:

(a) Where there are combined neurosurgery spine cases to be discussed then Dominic Thompson, Consultant Neurosurgeon, to attend.

(b) Where there are neuromuscular cases to be discussed then Adnan Manzur, Neuromuscular Consultant, to attend.

(c) Where there are neuro-disability cases Catherine DeVile +/- Belinda Crowe will be invited

(d) Where additional radiological (including neuro radiological) experience is required then an appropriate consultant radiologist will be invited.

(e) In the event of complex cardiac patients, including patients needing ECMO backup, the Consultant Cardiologist must be in attendance at the MDT
For patients with known pulmonary hypertension, a specialist pulmonary hypertension consultant must be in attendance for the discussion of the patient.
The cardiologist/ pulmonary hypertension consultant will then decide if it necessary for the patient to be discussed further at the cardiac joint case conference (JCC) and will make this referral directly.
All patients identified as potential candidates for ECMO backup must be discussed at the cardiac JCC. The outcome of the JCC discussion must be fed back at the subsequent Spinal MDT meeting by the Consultant Cardiologist. In the event of clinical urgency, the Consultant cardiologist should feedback to the Spinal CNS team and arrangements will be made for an ad hoc MDT.

(f) Other clinicians may be invited to the meeting on an adhoc basis depending on the clinical needs of the patient due to be discussed.

The group membership is agreed and detailed below:

Spinal MDT Attendance List

Name	Title	Attended	Arrival Time
Adnan Manzur	Neuromuscular Consultant		
Aimi McEwan	Physiotherapist		
Caroline Haynes	Occupational Therapist		
Claire Cook	Spinal Theatre Sister		

Dominic Thompson	Consultant Neurosurgeon		
Edel Broomfield	Advanced Nurse Practitioner		
Elaine Chan	Respiratory Consultant		
Evangelia Papathanasiou	Cardiology Consultant		
Francois Abel	Respiratory Consultant		
Grant Stuart	Consultant Anaesthetist		
Hiromi Kawai	Administrator		
Imke Meyer-Parsonson	General Paediatrician		
Ioannis Ioannou	Consultant Anaesthetist		
Jonathan Smith	Consultant Anaesthetist		
Joy Dawes	Consultant Anaesthetist		
Sophie Tamiam	Medical Secretary		
Liz Jackson	Consultant Anaesthetist		
Loren Wailes	Clinical Nurse Specialist		
Lucy Howlett	Clinical Nurse Specialist		
Marina George	Consultant Anaesthetist		
Mark Harris	Consultant Spinal Surgeon		
Pascale Du Pre	PICU consultant		
Pratheeban Nambyiah	Consultant Anaesthetist		
Ramesh Nadarajah	Consultant Spinal Surgeon		
Sarah Harmar	Physiotherapist		
Sian Pincott	General Paediatrician		
Stacey Lambourne	Clinical Nurse Specialist		
Saadiyah Dana	Medical Secretary		
Stewart Tucker	Consultant Spinal Surgeon		
Sophie Tamiam	Spinal secretary		
Suzanne Close	Physiotherapist		
Tom Ember	Consultant Spinal Surgeon		

4 Operational Processes

From September 2019: One meeting per month, on a Tuesday for 4 hours (i.e. one PA DCC time per month or 0.25 per week).

MDT Schedule:

	Theatre 14 Start time	**Theatre 15 Start times**
26/11/2019	12:00	08:15
17/12/2019	08:15	12:00
21/01/2020	08.15	11.00
18/02/2020	08.15	11.00
17/03/2020	08.15	11.00
14/04/2020	08.15	11.00
12/05/2020	08.15	11.00
19/06/2020	08.15	11.00
07/07/2020	08.15	11.00
04/08/2020	08.15	11.00
01/09/2020	08.15	11.00
29/09/2020	08.15	11.00

27/10/2020	08.15	11.00
24/11/2020	08.15	11.00
22/12/2020	08.15	11.00

5 Chair

The meeting is alternately chaired by Mark Harris, Spinal Surgeon and Imke Meyer Parsons, Consultant Paediatrician. The name of the chair will be confirmed in the minutes of the MDT meeting.

The chair is responsible for ensuring that the TOR are followed. This includes ensuring that the meeting is appropriately quorate for the discussion of each patient.

If the named consultants (or appropriate deputies) required to discuss a case are absent, the patient case discussion will be deferred until the next meeting. In the event of clinical urgency, then an ad hoc MDT meeting with the relevant professionals must be arranged.

If feedback and advice is sought from another MDT or professional before confirming a spinal MDT decision, the chair must ensure that the case is re-listed at the next spinal MDT or make arrangements for and ad hoc MDT meeting with the relevant professionals must be arranged.

6 Administration

6.1 Meeting Notifications

Group core members will be notified of meeting dates and changes to meeting data in advance with a minimum of three weeks' notice.

6.2 Documentation

Minutes should either be typed directly into Epic at the meeting (or using voice recognition software) by the Advanced Nurse Practitioner. The notes taken at the meeting will be reviewed with the meeting chair for sign off. The minutes must be signed off by the chair within 2 working days.

6.3 Attendance

All core members of the MDT are required to attend the meeting.

In exceptional cases where core member attendance is not possible, a suitable deputy, who is briefed and at an appropriate level to make decisions in a members absence, should be arranged by the named specialty consultant. Apologies, together with the deputy's details must be sent to the SMDT administration support by the named specialty consultant.

7 Monitoring

The service manager for the spinal service, together with the core SMDT members shall review its effectiveness through audit on an annual basis. This will involve monitoring and reporting on:

- Frequency of meetings
- Attendance at meetings; and
- Compliance with the requirements outlined in the terms of reference

The spinal MDT terms of reference will be reviewed by the service manager, in conjunction with members of the MDT, on an annual basis or more frequently if needed.

Changes in the TOR must be approved at the MDT meeting.

Next review due: November 2020

Spinal Surgery Pathway for Patients Admitted to PICU

Surgical pathway applicable for combined, anterior and posterior approach spinal fusion, and insertion of growth rods. (Full integrated care pathways available on EPIC)

Appendix 1- spinal MDT decision flow chart for complex cardiac patients

Appendix 2- pulmonary hypertension pathway

Pre-operative assessment

Each spinal patient is discussed in the spinal MDT and assessed for risk by; respiratory, cardiology, anaesthetic and spinal surgery. Other specialties attend as indicated e.g. pulmonary hypertension and neuromuscular team. All patients with complex cardiac conditions, significant pulmonary hypertension or cardiac failure discussed in the JCC and discussion fed back to Spinal MDT **(see appendix 1)**. Indication for surgery and appropriateness of surgery given risk is discussed. PICU representative must be present at each meeting, provisionally accepts if appropriate and flags high risk patients to spinal CNS. Any specific post-operative recommendations are documented in MDT notes.

Certain high-risk patients discussed at PICU consultant meeting at PICU links discretion for disseminating information and plan refinement (will include but not exclusive to patients with complex cardiac co-morbidities). Disagreement to be fed back to spinal MDT by PICU link.

PICU bed to be requested by spinal CNS on EPIC stating; high risk spinal patient, surgery planned and indication for PICU.

PICU link and PICU clinical lead informed of scheduled admission of high-risk patients by spinal CNS by e-mail the week before surgery. PICU link updates admitting Consultant team (1st, 2nd and support PICU Consultant on call) with high risk status and any specific post-op recommendations. PICU link to include relevant specialties as required.

Admission

Admission as requested by spinal team. Patients with pulmonary hypertension being stabilised on IV sildenafil pre-op admitted to PICU for cardiology and pulmonary hypertension team review **(see appendix 2)**

High risk patients to be prioritised on theatre list aiming to return from theatres before 1900.

Intra-operative management

Intra-op management as per spinal anaesthetic team. Patients with pulmonary hypertension to continue IV sildenafil if already established on it and inhaled nitric oxide to be available.

Spinal Surgery Pathway for Patients Admitted to PICU

Post-operative management- High risk patients

Transferred to PICU ventilated with IABP monitoring.

Anaesthetic Consultant to PICU Consultant handover on PICU. Handover to include high risk status, post-op recommendations and discussion on timing of extubation. PICU Consultant to co-ordinate post-op management.

Patients with Pulmonary Hypertension (see appendix 2): start CVP monitoring, continue IV sildenafil with inhaled nitric oxide available. Optimise analgesia, avoid acidosis, avoid hypoxia (physiotherapy and optimising lung volumes), and avoid hypotension (whilst avoiding fluid overload). Oral sildenafil to be reintroduced once tolerating feeds.

Cardiology and pulmonary hypertension team assessment pre-extubation and pre-discharge to HDU as indicated. Extubation once stable after first night post op during day shift.

Patients with known pulmonary hypertension with signs of pulmonary hypertensive crisis or low cardiac output at any stage: Medical management optimisation as above, achieve alkalosis, high FiO2, inhaled nitric oxide, inotropes to achieve systemic blood pressures above pulmonary pressures and consider milrinone if systemic pressure allows. **Urgent cardiology review and ECLS/CICU referral if evidence of ongoing low cardiac output or hypoxia.**

Patients with difficult airway or high risk of tracheostomy also to be extubated in working hours with appropriate teams informed as indicated by intraoperative assessment or pre-op plan. If known to be difficult to bag mask ventilate theatre availability for extubation should be confirmed pre-op. Handover to ward teams and involved specialties with CSP review prior to discharge as per usual care.

Spinal surgery- low risk and usual post-operative care

PICU post-operative care-day of admission

Sky bed to be sent when patient ready for collection

Anaesthetic team hand over including any specific post-operative recommendations

Post-op plan and timing of extubation if ventilated discussed with PICU Consultant

Commence ABP monitoring as indicated. Routine post-operative observations ¼ hourly

Chest X-Ray

Keep NBM, commence IV fluids, and place NG tube on free drainage

Administer analgesia IV / PR as required. Monitor pain scores hourly

Monitor and record neurovascular observations ½ hourly for the first 4 hours then hourly

Monitor wound site for oozing – apply pressure dressing if required

Monitor urine output- medical review if urine output below 1ml/kg/hour

Administer IV antibiotics as per microbiology policy and ensure prescribed at the correct time post dose in theatres.

Post combined or anterior spinal fusion; monitor and record chest drain loses hourly

Nurse supine for 12 hours then log roll 2 hourly, attending to pressure area care at least 2hourly

Obtain post-operative blood samples for FBC, U+E and clotting

Low risk patients highlighted for early discharge discussed at evening bed meeting and night CSP to review before handing over (including patient's extubated at 0600). Day team to review if still ventilated

Post-procedure day 1 – Transfer from PICU to post-operative ward

Ensure arterial line removed after doing post op bloods if no longer required and transfer to Sky bed if not already done.

Catheter to remain in situ

Central line to remain in situ

Pain team review and PCA/NCA converted to ward settings prior to discharge

Review on post-operative ward round by spinal team

Handover from intensive care team to spinal team

CSP review prior to discharge if not already done

Post-procedure day 1 usual ward care if still on PICU is as follows;

Continue to monitor neurovascular observations hourly

NBM, continue IV fluids, NG tube on free drainage

Check for bowel sounds – consider commencing oral fluids if present and spigot NG tube

If IV fluids continue – obtain blood sample for U&E

Convert NCA to PCA after pain team review, monitor pain scores hourly

Monitor wound site for oozing and administer IV antibiotics as per policy

Monitor urine output-medical review if urine output below 1ml/kg/hour

Monitor and record chest drain loses

Assist to turn 2hourly and attend to pressure area care at least 2hourly

Review by physiotherapist and OT daily as indicated; Sit or mobilise as directed by operation note

Contact orthotics were appropriate to arrange timing of cast for brace if required

Spinal Surgery Pathway for Patients Admitted to PICU

Post-procedure day 2, Instructions as per day 1 except;

Listen for bowel sounds and commence oral fluid if present

If IV fluids continued obtain blood sample for U&E

Spigot NG tube and remove once tolerating oral fluid and diet

Pain team review and convert PCA to oral medication when tolerating enteral diet

Remove catheter if appropriate once off opiates– ensure urine passed within 12 hours

Attend to pressure area care as a minimum 2 hourly

If no brace required sit to angle as directed by operation note

Post-procedure day 3, Instructions as per day 2 except;

Monitor and record chest drain loses – remove when less than 150ml in 24 hours and chest x-ray review. Obtain chest x-ray pre and post removal

Commence laxatives if bowels not open

Assist with turns and attend to pressure area care 2 to 4 hourly

Discharge process as above

Spinal Surgery Pathway for Patients Admitted to PICU

Appendix 1- spinal MDT decision flow chart for high risk cardiac patients

Patients referred to **Spinal MDT** with complex cardiac conditions, significant heart failure, pulmonary hypertension or referred for ECLS back up. Discussed in JCC if not already done.

Joint Cardiac Conference (JCC)- to discuss risk, need for specific cardiac management, suitability for ECLS and post op destination

Re-discussed in **Spinal MDT** for final decision on suitability for surgery and peri-operative planning- flagged as high risk to Spinal CNS by PICU link

Decision to admit to CICU

CICU bed requested, ECLS team to counsel family if back up ECLS bed required. Spinal CNS to liase CICU the week prior to surgery. Anaesthetic team to check bed availability the morning of surgery.

Decision to admit to PICU

PICU bed requested and PICU link to discuss in PICU consultant meeting for dissemination of information, post op plan refinement. Disagreement brought back to spinal MDT by PICU link. If ECLS back up appropriate PICU link to liase with ECLS lead the week prior to surgery and anaesthetic team to check bed availability and ECLS capacity the morning of surgery.

Appendix 2- perioperative management of spinal patients with Pulmonary Hypertension (pHTN)

Pragmatic definition of pHTN: Any patient with the label of pHTN or on treatment for pHTN. Cardiology to refer to pHTN team if concerned and not previously known to pHTN team.

Cardiology/pHTN team to decide if further vascular studies to assess pulmonary hypertension required

Risk assessment and risk for surgery to be discussed in spinal MDT. Patients with pHTN not controlled by medication not suitable for surgery until stable.

Cardiology/pHTN team to discuss complex patients or those referred for ECLS back up in JCC.

Pre-op admission to PICU to stabilise on IV sildenafil 24-48hrs prior to surgery to mitigate poor enteral absorption post operatively.

Echo assessment on admission pre first dose of IV sildenafil and 4-6 hours post 2nd or 3rd dose. Cardiology and/or pulmonary hypertension team to review pre op to check estimation of pulmonary pressures.

IV sildenafil to continue day of surgery and post op until tolerating enteral feeds and medications. Other enteral medications for pulmonary hypertension such as Bosentan to continue throughout.

Patients with Pulmonary Hypertension: start CVP monitoring, continue IV sildenafil with inhaled nitric oxide available. Optimise analgesia, avoid acidosis, avoid hypoxia (physiotherapy and optimising lung volumes), and avoid hypotension (whilst avoiding fluid overload). Oral sildenafil to be reintroduced once tolerating feeds.

Cardiology and/or pulmonary hypertension team assessment pre-extubation to ensure estimated pulmonary pressures stable compared to pre-operative assessment and pre-discharge to HDU. Extubation once stable after first night post op during day shift.

Patients with known pulmonary hypertension with signs of pulmonary hypertensive crisis or low cardiac output at any stage: Medical management optimisation as above, achieve alkalosis, high FiO2, inhaled nitric oxide, inotropes to achieve systemic blood pressures above pulmonary pressures and consider milrinone if systemic pressure allows. Urgent cardiology review and early ECLS referral if evidence of ongoing low cardiac output or hypoxia.

Amy's journey in 2018

- Case reviewed at non-quorate Spinal MDT, ECMO potential noted – decision to proceed to surgery
- Spinal pre-assessment process and consent
- Admission to Ward
- Anaesthetist confirms PICU bed availability
- Operation in Theatre
- Handover from Anaesthetics to ICU
- PICU for post operative care
- Extubation out of hours
- Patient deterioration and clinical need for ECMO support identified
- ECMO team called in from home
- ECMO commenced following assessment

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What happens now

- Case reviewed at quorate Spinal MDT and ECMO potential noted
- Patient referred to JCC by Cardiology Consultant who attended spinal MDT
- JCC assess risks and benefits of ECMO & confirm post operative location
- Cardiologist feedback to Spinal MDT. Spinal MDT decision to proceed to surgery
  - MDT documented in patient record on Epic
- Patient and family provided with ECMO information and counselling
- Pre-assessment process and consent
- Admission to ward
  - Patient discussed at the PICU Consultants meeting
  - Spinal CNS high risk patient reminders one week before and on day of admission
  - PICU link consultant will liaise with ECMO team 1 week prior to admission regarding capacity
- Anaesthetist confirms PICU bed and ECMO availability
- Operation in Theatres
- Consultant level handover from Anaesthetics to ICU using structured form
- PICU/CICU for post op care
- PICU & CICU to notify perfusion of high risk patient, so perfusionist stays on site
- Extubation in line with guidance/clinical need