

Burns Fluid Resuscitation

	Title of Guideline	Guideline on Fluid Resuscitation in Paediatric Burn Injuries
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	Directorate & Speciality	Family Health: Burns
	Date of submission	July 2021
	Date on which guideline must be reviewed (one to five years)	May 2024
	Guideline Number	2243 – Version 3
	Explicit definition of patient group to which it applies (e.g. inclusion and exclusion criteria, diagnosis)	In children, most centres in the developed world now advocate fluid resuscitation, using a formal fluid formula, for burns of 10% total body surface area (%TBSA) or greater. Care should be taken in children who will be fasting, to ensure that maintenance fluids are administered <i>in addition</i> to any resuscitation fluid ³ .
	Abstract	The most widely-used fluid regime is the Parkland Memorial Hospital formula, described by Baxter and Shires in 1968 ¹ .
	Key Words	Paediatrics.Child. Burns. Fluid. Resuscitation
	Statement of the evidence base of the guideline – has the guideline been peer reviewed by colleagues?	
1a	meta analysis of randomised controlled trials	
2a	at least one well-designed controlled study without randomisation	
2b	at least one other type of well-designed quasi-experimental study	X
3	well –designed non-experimental descriptive studies (ie comparative / correlation and case studies)	
4	expert committee reports or opinions and / or clinical experiences of respected authorities	X
5	recommended best practise based on the clinical experience of the guideline developer	X
	Consultation Process	Burns Multi-Disciplinary Team to include: Mr O'Boyle, Mr Alexander, Mr Hasham, Dr Davies and Andrea Cronshaw, Dr Fletcher, Terri Jones-Hall; Staff of Nottingham Children's Hospital via the guideline email process
	Target audience	Staff within Nottingham Children's Hospital
	This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date.	

Document Control

Document Amendment Record

Version	Issue Date	Author
V1	November 2014	Mr O'Boyle A Cronshaw
V2	July 2018	Mr O'Boyle A Cronshaw
V3	May 2021	Mr O'Boyle A Cronshaw

General Notes:

Summary of changes for new version:

- Updated fluids for fluid resuscitation from Muir and Barclay formula to solely Parkland Formula.
- Clarified aims of fluid resuscitation.
- Clarified escalation policy for burns.
- Clarified observations required during resuscitation period.
- Provision of flow chart for fluid resuscitation.
- Provision of flow chart for escalation of burns.
- Provision of flow chart for monitoring fluid resuscitation.
- Provision of 'crib sheet' for staff to calculate fluid resuscitation.

Statement of Compliance with Child Health Guidelines SOP

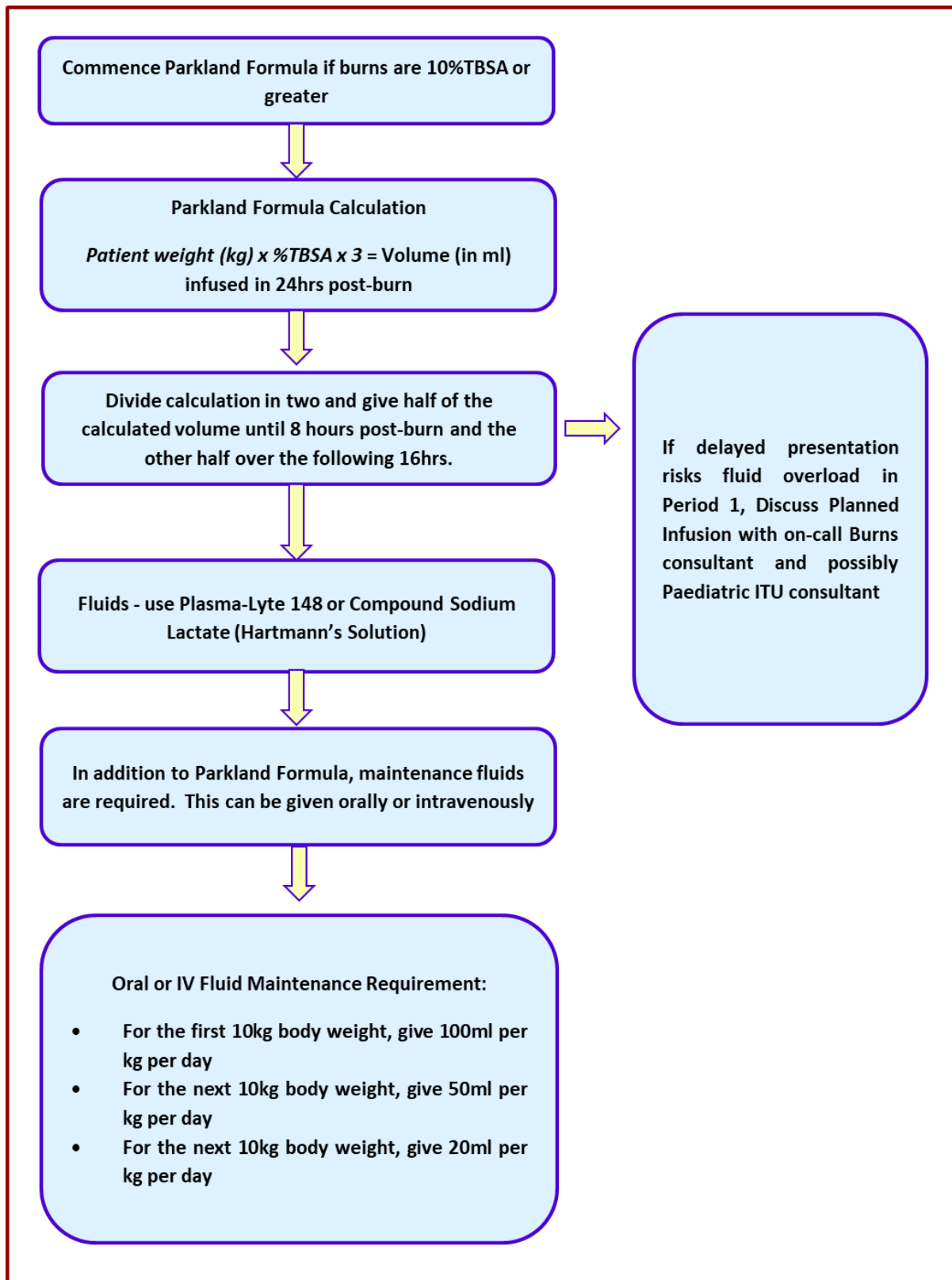
This guideline has followed Child Health Guideline SOP. It has been circulated to all Paediatric Senior staff and comments incorporated before uploading to the Trust Guideline site.

Maria Moran

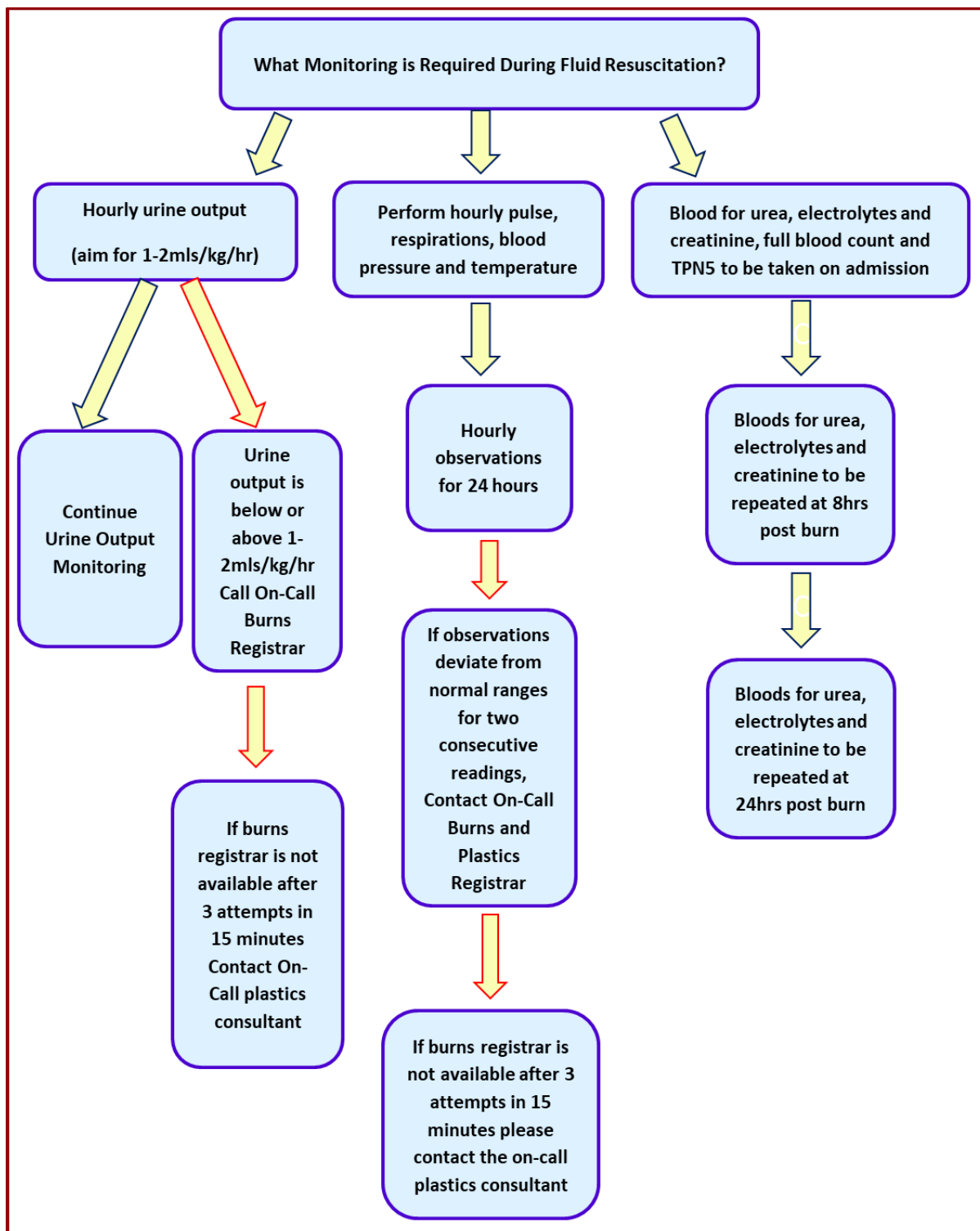
Clinical Guideline Lead

3 August 2021

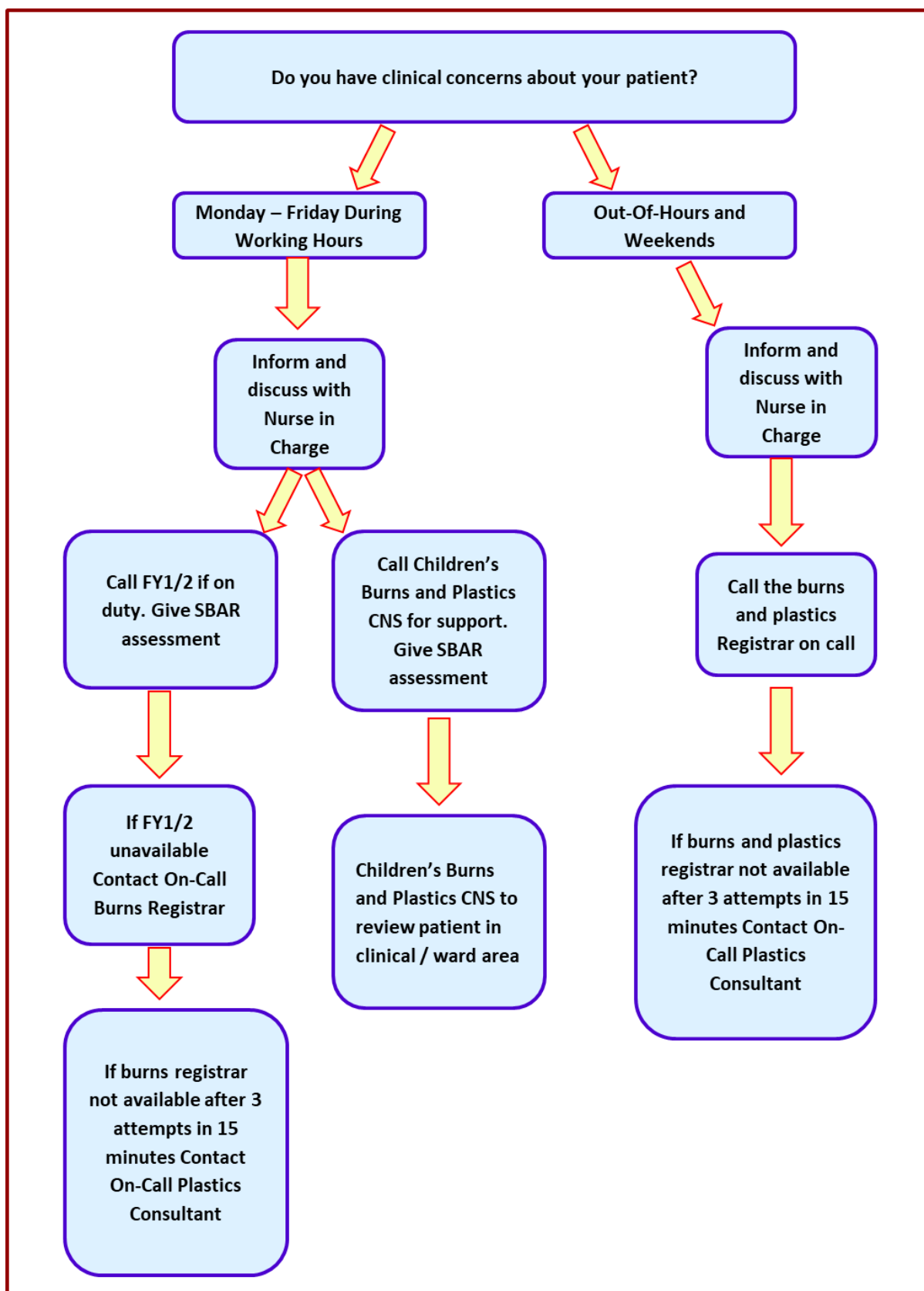
NUH Paediatric Resuscitation Regime – Flow Chart



Monitoring During Paediatric Burns Resuscitation – Flow Chart



Children's Burns Nursing Escalation Guidance



GUIDELINES ON FLUID RESUSCITATION IN PAEDIATRIC BURN INJURIES

Background

Burn injury causes a systemic inflammatory response. The resulting changes in vessel permeability and fluid shifts may cause substantial fluid losses from intravascular to extravascular tissue spaces. This produces a relative hypovolaemia ("burn shock"), which was a major cause of acute burn-related deaths in the past. Adequate fluid replacement (termed "fluid resuscitation"), is known to improve survival from burn injuries^{1,2}. For children, fluid resuscitation is given using a fluid volume formula, for burns of 10% total body surface area (%TBSA), or greater. Care must be taken in children who will be fasting, to ensure that maintenance fluids are administered *in addition* to any resuscitation fluid³.

Peripheral Hospital Referrals

All burned patients must have a clinical estimation of burn size. The initial burn size estimation from a referring Emergency Department is difficult and may be inaccurate. Re-estimation is required following admission. This must not delay commencement of fluid resuscitation.

The child must be reviewed by the senior clinician at the referring Emergency Department (ED). The NUH Burns Service must ensure that the referring Emergency Department has used a correctly age-matched burns chart⁴, accepted general rules for burn size estimation³, or Mersey Burns App.

Areas of simple erythema (ie: areas of red skin, with no blistering) must *not* be counted in the burn size estimate. If there is doubt about the burn size (EDs tend to over-estimate, rather than under-estimate burn size), discuss with the on-call NUH consultant, keep the patient at the referring ED and observe for a further hour, then re-assess the burn size, before transferring to NUH. This avoids the risks associated with a long transfer, with inappropriately large infusions running.

Who Needs Resuscitation Fluids?

TBSA needs to be assessed using the Mersey Burns App or Lund and Browder charts.

Burns of between 8% and 10%TBSA are given maintenance fluids, according to the maintenance fluid formula below.

Burns of 10%TBSA or greater in children require fluid resuscitation in addition to maintenance fluids⁵⁻¹¹. The volume and rate of infusion are described below.

NUH burn service recommends the use of Plasma-Lyte 148, or Hartmann's Solution, in the first 24 hours after burn injury.

All burned children requiring resuscitation fluids must be seen face-to-face, by the on-call Plastic Surgery consultant within 6 hours of admission.

Starting the Infusion

Cannula

Children requiring fluid resuscitation must have two intravenous cannulae sited in reliable positions and have these sites protected from movements which could impair the infusion.

Monitoring Urine Output

All children requiring fluid resuscitation should have a reliable means of measuring urine output. Burns of 20% TBSA and over must have a urinary catheter and hourly urometry.

Burns of less than 20%TBSA are not catheterised, but provision must be made for weighing of nappies or direct bottle-measurement of urine output. Urine output should be recorded hourly, even if patient wears nappies.

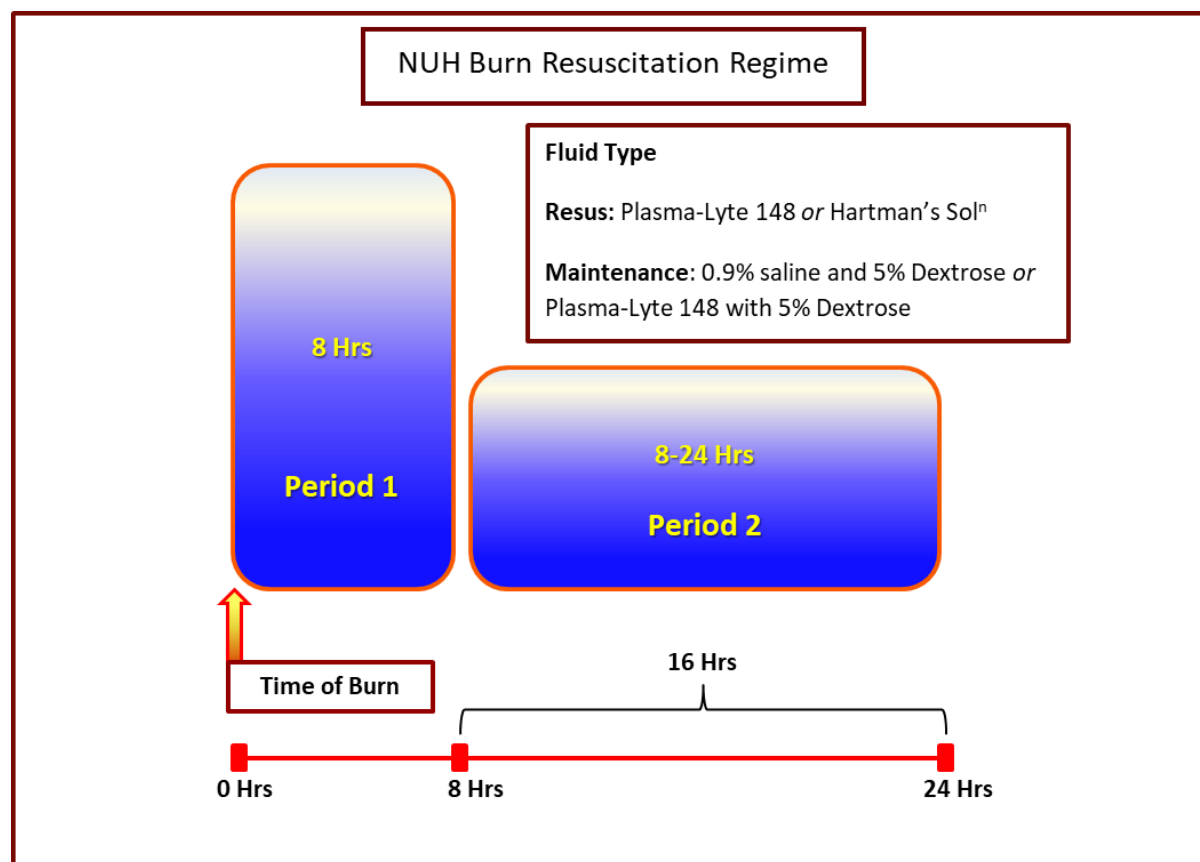
Aim of Resuscitation

During the resuscitation period, the urine output should be maintained at 1-2 ml per kg per hour.

Output of more than 2ml/kg/hour for more than two hours may require reduction of the infusion rate and must be discussed with the on-call plastic surgery registrar, or consultant.

Output of less than 1ml/kg/hour will require an increase in the infusion rate and must be discussed with the on-call plastic surgery registrar, or consultant.

NUH Paediatric Resuscitation Regime



Resuscitation Formula

The Parkland Formula is used to calculate the volume and rate of infusion of resuscitation fluid.

$$\text{Patient Weight (kg)} \times \%TBSA \times 3 = \text{Volume infused in 24 hours Post-Burn}$$

Half of this volume is infused in the first 8 hours post-burn (Period 1).
Half is infused over the following 16 hours (Period 2).

Points to Remember

Period 1 is *not* simply an 8-hour infusion calculation. The aim is to have infused all of the Period 1 volume by the time the patient reaches 8 hours post-burn. The patient will be seen *after* the time of their burn, so the infusion schedule for Period 1 will always be less than 8 hours.

In cases of delayed presentation, it may not be possible to infuse all of the Period 1 volume within the 8 hour time frame. If this is the case, then the resuscitation schedule must be discussed and calculated with the on-call Burns consultant and possibly Paediatric ITU consultant.

Paediatric Maintenance Fluids

In patients requiring fluid resuscitation, oral fluid intake is encouraged when possible.

If fasting, IV maintenance fluid must be administered *in addition* to the resuscitation formula. The IV maintenance fluid formula is based upon a patient's weight (kg) over 24 hours, using Plasma-Lyte 148 with 5% glucose, or glucose/sodium chloride (5% glucose/0.9% sodium chloride) as follows:

- 100mls per kg per 24 hours for the first 10kg of weight
- 50mls per kg per 24 hours for the second 10kg of weight
- 20mls per kg for the weight over 20kg

Therefore, the maintenance requirements in a child weighing 22kg would be $(100 \times 10) + (50 \times 10) + (20 \times 2) = 1540\text{ml}$ over 24 hours.

The total volume of maintenance fluid infused per 24 hour period should not exceed 2L for females and 2.5L for males.

Monitoring Maintenance Fluid Input

The volume of infused fluid must be recorded hourly for minimum of 24 hours.

All resuscitation burns must be referred to the burns dietician.

Resuscitation Management in NUH, for Junior Medical and Nursing Staff

NUH uses Plasma-Lyte 148, or Hartmann's Solution for paediatric burns resuscitation fluid. This must be prescribed and signed on the drug chart.

All children with burns over 10%TBSA must be seen and assessed by the on-call plastic surgery consultant within 6 hours of admission.

All children with burns between 8% and 10%TBSA must have maintenance fluids.

Discuss and prepare the child for general anaesthetic for scrub; burn re-assessment; re-documentation and application of Biobrane, or EpiProtect.

Monitoring of urine output is essential in children with resuscitation fluids running. In burns of 20%TBSA, or greater and in all burns over 10%TBSA that involve the genitals, a urinary catheter must be passed and hourly urometry commenced. In burns of less than 20%TBSA, nappies must be weighed or urinary volumes measured by bottle or pan. Urine output should be recorded hourly.

If a urinary catheter is required and this cannot be sited on the ward, then the child must have a urinary catheter sited under general anaesthetic in theatre. This must be booked as an urgent case, to be done within 2 hours and may require the assistance of a paediatric surgeon.

No child can be left day or night without hourly urine output measurement, even if they wear nappies.

Poor urine output (output less than 0.5ml/kg/hour for two hours), or no urine output for two hours, must be reported to the plastic surgery registrar covering children's burns during working hours, or to the on-call Plastic Surgery registrar out of working hours (see section on **Monitoring**). If the registrar cannot be reached, then the on-call Plastic Surgery consultant must be informed directly.

In addition if urine output is low and no catheter sited to review if a bladder scan would be required.

Monitoring During Paediatric Burns Resuscitation

Patients receiving fluid resuscitation require regular monitoring as follows:

Aim for 1 to 2mls/kg/hr output. Low (<1ml/kg/hour) or high (>2.0ml/kg/hour) urine output for 3 or more sets of hourly observations must be escalated to the burns registrar or consultant, or the on-call plastic surgery registrar or consultant. The burn may need to be re-assessed. Over-infusion is as dangerous as under-infusion.

For burns between 10% and 20%TBSA, a catheter is not sited. These children must have hourly measurements of urine volume output by measurement from a bottle or pan, or by weighed nappies. The fact that a child does not have a catheter in place does not mean that urine output measurements are any less important. All burned children receiving resuscitation fluids must have hourly records

Hourly pulse, blood pressure and temperature observations to be recorded for 24 hours post burn.

Blood for urea, electrolytes and creatinine, full blood count initially on admission, then repeated at eight hours post-burn, 24 hours post-burn and 36 hours post-burn. In addition, patients require blood to be sent for TPN-5, LFT, bone profile on admission, or at first theatre procedure.

Children's Burns Resuscitation Fluids – A Crib Sheet For Staff

PATIENT IDENTIFIER STICKER

TIME OF BURN

TIME OF FLUID PRESCRIPTION

Parkland Formula

Pt Weight (kg) x %TBSA x 3 = Volume infused in 24 hours Post-Burn

Half of this volume is infused in the first 8 hours post-burn (Period 1).

Half is infused over the following 16 hours (Period 2).

Weight x%TBSA x 3 = mls (volume to be infused over 24 hours)

P1 = to 8 hours post-burn =mls/hr

P2 = from 8 to 24 hours post-burn =mls/hr

Maintenance Fluid

For the first 10kg weight, give 100ml per kg per 24 hours =

For the next 10kg weight, give 50ml per kg per 24 hours =

For the next 10kg weight, give 20ml per kg per 24 hours =

Total fluids to be given over 24 hrs =/ 24 =mls/hr

Observations

Minimum of hourly observations for 24 hours post-burn to include heart rate, respirations, oxygen saturations, blood pressure and temperature.

Urine Output

Urine output to be 1-2mls/kg/hr. To catheterise if burn above 20% TBSA.

****DO NOT GIVE FUROSIMIDE IF POOR URINE OUTPUT****

References

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