

**SCHEDULE OF GUIDELINE REQUIREMENTS & CONOR’S TREATMENT<sup>1</sup>**

*“Any child on IV fluids or oral rehydration is potentially at risk of hyponatraemia” – Ref: 006-054-438*

<b>Guideline Heading</b>	<b>Guideline Requirements</b>	<b>Description of Treatment</b>	<b>Dr. Scott-Jupp’s Views</b>
<b>Baseline Assessment</b> <i>Before starting IV fluids weight and U&amp;E must be measured and recorded</i>	<b>Weight:</b>  Accurately in kg (in a bed bound child use best estimate.) Plot on a centile chart or refer to normal range	Weight 22kg <sup>2</sup>  No centile chart or reference to normal range	<b>Compliance<sup>3</sup></b>  This is given as an ‘approximate weight’, it is not clear what that should be so if he was weighed  Centile chart not useful as Conor was not a normal child
	<b>U&amp;E:</b>  Take serum sodium into consideration	Blood tests on arrival at A&E Lab result 138mmol/l, blood gas	<b>Compliance<sup>4</sup></b>  Unclear if they knew lab result when infusion began,

<sup>1</sup> NB. Dr. Budd considered she had applied the principles of the Guidelines when treating Conor - Ref: WS-352/1, p.10-11. Dr. Murdock considers he failed to apply the Guidance only to the extent that he did not document the process he followed - Ref: 087-007-059; Ref: WS-355/1, p.15. Dr. Mike Smith (consultant paediatrician) considers that treatment in the Emergency Department was consistent with the Guidelines but there were deficiencies in documentation of IV fluids and no documentation of urinary output - Ref: 087-007-059 & Ref: WS-355/1, p.15

<sup>2</sup> Dr. Budd states: “Conor was weighed and recorded at approximately 22kg” - Ref: WS-352/1, p.7. Dr. Sumner observed “I think it is regrettable that Conor was not nursed in a paediatric environment as he was small for his age, weighing only 22kg” - Ref: 087-056-220

<sup>3</sup> Ref: 260-002-012

<sup>4</sup> Ref: 260-002-012

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		136mmol/l.	but likely had the blood gas result. Blood gas can be unreliable and differ significantly from lab result, but justifiable to begin IV fluids on this basis.
<p><b>Fluid Requirements<sup>5</sup></b>  <i>Fluid needs should be assessed by a doctor competent in determining a child's fluid requirement. Accurate calculation is essential and includes maintenance &amp; replacement fluids</i></p>	<p><b>Maintenance fluid:</b></p> <ul style="list-style-type: none"> <li>▪ 100mls/kg for first 10kg body wt, plus</li> <li>▪ 50mls/kg for next 10kg, plus</li> <li>▪ 20mls/kg for each kg thereafter up to max of 70kg</li> </ul> <p>[This provides the total 24 hr calculation; divide by 24 to get the mls/hr]</p>	<p>Conor was seen by a staff grade A&amp;E doctor (Dr. Budd) and an A&amp;E consultant (Dr. Kerr) in A&amp;E. He was seen by a medical SHO (Dr Quinn) and medical Registrar (Dr Murdock) in MAU</p> <p>According to the Guideline formula, Conor should have received maintenance fluids at 63ml/hr</p> <p>First maintenance prescription of 1 litre normal saline over 8 hours x 3 (125ml/hr) This was deleted after Dr</p>	<p><b>Non-compliance<sup>6</sup></b></p> <p>None of those seeing him initially were likely to have had the necessary skills, particularly in assessing a disabled child.</p> <p>No evidence of use of formula in maintenance calculation – usual in paediatric practice to record the calculation.</p> <p>No evidence it was</p>

<sup>5</sup> In his report to the Coroner, Dr. Sumner queried: *“was the initial rate of administration too great for Conor? Ref: 087-056-220. After the Inquest he wrote to Dr. Jenkins (cc to the Coroner and CMO) and expressed his disquiet about fluid management in Conor’s case which he described as “suboptimal” - Ref: 087-062i-247. He went on to state: “There was a lapse in infusion for some hours and then 250ml saline were ordered to run over four hours and then a further 250ml over six hours. The basis of these amounts makes no sense to me at all” - Ref: 087-062i-247.*

<sup>6</sup> Ref: 260-002-014

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		<p>Quinn consulted with Dr Murdock. This was deleted and not acted upon.</p> <p>Second prescription of 250mls over 4 hours; 250mls over 6 hours &amp; 250mls over 8 hours (avg. 42ml/hr)</p>	<p>considered and prescribed separately.</p> <p>Clearly inappropriate, but not acted upon.</p> <p>Actually a restricted quantity of fluids, likely written with the expectation that he would take oral fluids later</p>
	<p><b>Replacement fluid:</b></p> <ul style="list-style-type: none"> <li>▪ Must always be considered and prescribed separately</li> <li>▪ Must reflect fluid loss in both volume and composition (lab analysis of the sodium content of fluid loss may be helpful)</li> </ul>	<p>220ml (10ml/kg) of Hartmann's prescribed as a fluid bolus. May have received up to 440ml (20ml/kg)</p>	<p><b>Non-compliance<sup>7</sup></b></p> <p>No estimate of fluid output, so could not reflect fluid loss.</p> <p>No calculation of estimated replacement requirement.</p> <p>Confusion between resuscitation and replacement fluids – prescribed as bolus, but given over longer time,</p>

<sup>7</sup> Ref: 260-002-013 & 014

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			therefore replacement
<p><b>Choice of Fluid</b>  <i>Hyponatraemia may occur in any child receiving IV fluids or oral rehydration. Vigilance is needed for all children receiving fluids</i></p>	<p><b>Maintenance fluids:</b></p> <ul style="list-style-type: none"> <li>▪ Must in all instances be dictated by the anticipated sodium and potassium requirements</li> <li>▪ The glucose requirements, particularly of very young children, must also be met</li> </ul>	<p>Received normal saline, which contained the required electrolytes.</p> <p>Blood tests at admission showed no sodium, potassium or glucose issues.</p>	Compliance <sup>8</sup>
	<p><b>Replacement fluids:</b></p> <p>Must reflect fluid lost. In most situations, this implies a minimum sodium content of 130mmol/L</p>	<p>Hartmanns (sodium content 131mmol/l) and normal saline (150mmol/l) were administered.</p>	Compliance <sup>9</sup>
	<p><b>Resuscitating a child with clinical signs of shock:</b></p>		Non-compliance but did not apply <sup>10</sup>

<sup>8</sup> Ref: 260-002-016

<sup>9</sup> Ref: 260-002-016

<sup>10</sup> Ref: 260-002-016. The Trust has stated that the Guidance does not specify particular fluid choices, and while normal saline was 'appropriate' according to the Guidance, in these circumstances so was Hartmann's - Ref: 260-003-004. This was in fact what might have been addressed by the 'local protocols' that were also to be developed

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	<p>If a decision is made to administer a crystalloid, normal (0.9%) saline is an appropriate choice, while awaiting the serum sodium</p>	<p>Hartmann's used initially, normal saline later</p>	<p>Resuscitation fluid given was effectively replacement fluid because of the duration over which it was given.</p> <p>Unusual, but not inappropriate to use Hartmann's as a resuscitation fluid as it is isotonic, probably used as it was readily available in A&amp;E.</p>
	<p><b>Oral re-hydration fluids:</b></p> <p>Composition of these should also be carefully considered in light of the U&amp;E analysis</p>	<p>Not considered.</p>	<p>N/A<sup>11</sup></p> <p>Conor was never well enough to receive oral fluids.</p>
<p><b>Monitor<sup>12</sup></b></p>	<p><b>Clinical state:</b></p>		<p><b>Non-compliance<sup>14</sup></b></p>

<sup>11</sup> Ref: 260-002-016

<sup>12</sup> Dr. Sumner reported to the Coroner: "It is not clear how much intravenous fluid was actually given" - Ref: 087-056-218. In his subsequent correspondence he referred to: (i) there being "no written formal examination for [Conor's dehydration] such as skin turgor, capillary refill, though they did note his mouth was dry" - Ref: 087-062i-247; (ii) "There was no calculation of the degree of dehydration nor the fluid deficit and no calculation of the maintenance fluids for a 22kg child", and (iii) that it was his impression "that the basics of fluid management are neither well understood, nor properly carried out" - Ref: 087-062i-248

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<p><i>Fluid balance must be assessed at least every 12 hours by an experienced member of clinical staff.</i></p> <p><i>If a child still needs prescribed fluids after 12 hours of starting, their requirements should be reassessed by a senior member of medical staff.</i></p> <p><i>The rate at which sodium falls is as important as the plasma level. A sodium that falls quickly may be accompanied by rapid fluid shifts with major clinical consequences.</i></p>	<p>Including hydrational status. Pain, vomiting and general well-being should be documented</p>	<p>Said to be 'dehydrated' / 'dry', but physical signs not listed<sup>13</sup></p> <p>No comment as to whether vomiting continued.</p>	<p>Conor's clinical state, particularly his degree of dehydration was not well monitored</p> <p>To make a full assessment of a child's hydration status, the following should be examined and documented:</p> <ul style="list-style-type: none"> <li>urine output                             <ul style="list-style-type: none"> <li>▪ urine concentration either observed or measured</li> <li>▪ vital signs</li> <li>▪ presence or absence of sunken eyes</li> <li>▪ dry tongue</li> <li>▪ loss of skin turgor</li> <li>▪ conscious level and responsiveness</li> </ul> </li> </ul> <p>No consideration in notes of use of NG tube / catheter</p>
	<p><b>Fluid balance:</b></p>		<p><b>Compliance<sup>15</sup></b></p>

<sup>14</sup> Ref: 260-002-017 & 018

<sup>13</sup> Dr. Budd told the Inquest into Conor's death that she considered him to be 5% dehydrated, that is, mildly dehydrated - Ref: 087-029-135

<sup>15</sup> Ref: 260-002-017 & 018

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	<ul style="list-style-type: none"> <li>▪ <b>Intake:</b></li> </ul> <p>All oral fluids (including medicines) must be recorded and IV intake reduced by equivalent amount.</p>	<p>No mention of oral fluids, but he may have been too ill to take these.</p>	
	<ul style="list-style-type: none"> <li>▪ <b>Output:</b></li> </ul> <p>Measure and record all losses (urine, vomiting, diarrhoea etc) as accurately as possible</p>	<p>Output column blank</p> <p>No record of urine output, vomiting or bowel movements</p>	<p><b>Non-compliance<sup>16</sup></b></p> <p>Output chart very poor</p>
	<p><b>Biochemistry:</b></p> <p>Blood sampling for U&amp;E is essential at least once a day – more often if there are significant fluid losses or if clinical course is not as expected.</p> <ul style="list-style-type: none"> <li>▪ Consider using an indwelling heparinised cannula to</li> </ul>	<p>Blood test for U&amp;E taken on admission. Transferred to PICU within 12hrs.</p>	<p><b>Compliance<sup>17</sup></b></p>

<sup>16</sup> Ref: 260-002-017 & 018

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	<p>facilitate repeat U&amp;Es</p> <ul style="list-style-type: none"> <li>▪ Do not take samples from the same limb as the IV infusion</li> <li>▪ Capillary samples are adequate if venous sampling is not practical</li> </ul> <p><b>Urine osmolarity/sodium:</b></p> <ul style="list-style-type: none"> <li>▪ Compare to plasma osmolarity</li> <li>▪ Consult a senior paediatrician or a chemical pathologist in interpreting results</li> </ul>	<p>No urine specimen was taken for osmolarity or biochemical analysis.</p> <p>Urine specimen taken at 13:30 and a dipstick test was done, which showed protein +, blood + and 'large ketones'. The specimen appears to have been sent to the lab for microbiological analysis to look for a UTI, but not for biochemical analysis</p>	<p><b>Non-compliance</b><sup>18</sup></p> <p>An assessment of urine concentration (i.e. urine specific gravity), was not done. Even without plasma and urine osmolarity, this is a useful indication of degree of dehydration. The small amounts of blood and protein are probably insignificant.</p> <p>The presence of a large amount of ketones in the urine suggests significant dehydration, but may have other causes and this test is not what is suggested in the</p>

<sup>18</sup> Ref: 260-002-017 & 018

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			<p>guidelines.</p> <p>More specific biochemical analysis would have helped quantify the degree of dehydration, and the ongoing requirement for fluid replacement.</p>
<p><b>Seek Advice</b></p>	<p>Advice and clinical input should be obtained from a senior member of medical staff, for example a Consultant Paediatrician, Consultant Anaesthetist or Consultant Chemical Pathologist</p>	<p>Conor was seen by staff grade doctor Dr. Budd.</p> <p>The only other senior member of medical staff asked for advice was a consultant physician (in fact a cardiologist, Dr McEaney) up until Conor's seizure and acute deterioration, apart from a very brief review by the A&amp;E consultant Dr Kerr.</p>	<p><b>Non-compliance<sup>19</sup></b></p> <p>Dr. Budd was relatively experienced, but the guidance is not clear on this point.<sup>20</sup></p> <p>A more senior doctor, particularly one with experience of young people with cerebral palsy, may have been able to make a better clinical assessment of his state of hydration, and may have asked for other</p>

<sup>19</sup> Ref: 260-002-018

<sup>20</sup> Ref: 260-004-006. NB. Dr. Budd noted: 'Admit paeds' (Ref: 088-020-002 & Ref: WS-352/1, p.6) but her request was declined by the paediatric SHO, whom she then asked to discuss the issue with his consultant but the refusal was maintained

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			action to be taken, including accurate documentation of fluid balance, urine specific gravity or osmolarity, further blood biochemistry, etc.
	In the event of problems that cannot be resolved locally, help should be sought from consultant paediatricians/ anaesthetists at the PICU, RBHSC	Conor was transferred to PICU, RBHSC	<b>Compliance</b>