The Child with Acute Diarrhoea (with or without vomiting)

POLICY pages 1-6  EVIDENCE BASE pages 7-32

This policy is for a child presenting with acute (<7 days) diarrhoea with or without vomiting. It does not deal with children who present with vomiting alone or chronic diarrhoea, when other diagnoses need to be considered.

Background
Diarrhoea is defined as a change in bowel habit for the individual child resulting in substantially more frequent and/or looser stools. The UK incidence of diarrhoeal illness in children is not known, but it leads to high GP consultation rates (204/1000/year in the 0-4 age group)\(^1\) and hospital admissions (at least 7/1000/year <5 years old)\(^2\). It accounts for 16% of all paediatric medical presentations to A&E (unpublished data). In 1996 OPCS data for England and Wales states that there were 58 deaths from intestinal infections in children 0-15 years, accounting for 0.9% of all causes of death in this age group\(^3\).

The vast majority of children have an infective cause, of which at least 80% is viral\(^4-6\). The commonest causative organism is rotavirus, with a peak rate of infection in infants 6-12 months, and marked seasonality, peaking in Jan to March each year\(^7\). The remaining 14% are predominantly campylobacter, salmonella, shigella and ecoli, in decreasing frequency. Acute infective diarrhoea is however a diagnosis of exclusion and other less common causes of diarrhoea must be considered and excluded first\(^4, 8\) (see Table 1,P5).

Principles of management
Morbidity and mortality are caused primarily by water and electrolyte losses in the stool. Thus the key to management is the prevention of dehydration and promotion of rehydration in those already dehydrated (see annotation 10). This relies on an accurate estimate of the level of dehydration (Table 2,P5). Rehydration should be done orally whenever possible and the keys to success are small amounts of Oral Rehydration Solution (ORS) frequently (Table 3,P6).

There is no place for the use of anti-diarrhoeal agents in children. (see annotation 22). Antibiotics are only of value in invasive disease (i.e. systemically unwell) and you should liase with the microbiologist once stool cultures are known.

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29/07/10
PRESENTING PROBLEM:
ACUTE DIARRHOEA +/- VOMITING

Evaluate and maintain A,B,C
Consider differential diagnoses. See Table 1. Refer to paediatric team if any uncertainty over diagnosis of acute infective gastroenteritis.

DIAGNOSIS OF EXCLUSION:
ACUTE INFECTIOUS GASTROENTERITIS

No signs, No dehydration, go to PAGE 3 (box 17)

Estimate severity of dehydration. See Table 2

Mild to moderate dehydration go to PAGE 2 (box 10)

Severe dehydration, with signs of circulatory compromise. Involve paediatric registrar or consultant.

Rapid bolus of 20ml/Kg Normal Saline

Is the circulation restored?

Yes

Na>150? No

Yes

Rehydrate over 3-4 hours (Table 3 for volume) with ORS, oral or NGT. (or IV 0.45% saline & 5%dext)

ADMIT to ward. Stool sample. 2 hourly review of hydration. If ORS failing (unimproved or worsening dehydration) consider NGT or IV fluids. If IVI in hyperatraemic patient, give rehyd. Maint. & losses over 48 HOURS. Post rehydration commence feeds (Table 6).

ADMIT to paediatric intensive care.

Further boluses of Normal Saline to a maximum of 40ml/Kg. If >40ml/Kg required involve anaesthetist early as intubation and ventilation should be considered.
ACUTE DIARRHOEA, MILD TO MODERATE DEHYDRATION (3-8%)

10. Any uncertainty over diagnosis? doughy skin?
   Yes: Check Ur/Cr/Elec/bicarb and consider other investigations (as for severe dehydration)
   No: ADMIT to Short Stay Unit. Rehydration over 4 hours (Table 3 for volume) with ORS. Regular review and Reassess at 4 hours

11. Na>150?
   Yes: Continue as on PAGE 1 (box 7)
   No: Still dehydrated?

12. Still dehydrated?
   Yes: Strongly Consider NGT ORS (preferred) or IV fluids (if IVI, check U&E). Regular review.
   No: Commence fluids and normal feeds at at least maintenance (Table 4&6). Observe for further 2-4 hours. Reassess.

13. Remains well hydrated?
   Yes: Advice to carer, give information leaflet. ORS sachets for home use if substantial losses continue.
   No: Carer happy to take child home?

14. Carer happy to take child home?
   Yes: DISCHARGE
   No: Continue management and carer education in HOSPITAL

29/07/10
Diarrhoea policy. Date for review Oct 2001

**ACUTE DIARRHOEA, NO SIGNS OF DEHYDRATION**

- Assess risk of dehydration

**HIGH RISK:**
- Age < 6 months or vomits* > 4/day or liquid stools* > 8/day.

Continue usual fluids at **at least** maintenance and encourage larger volumes. Replace substantial ongoing losses with ORS at 10ml/Kg per stool/vomit.

**ONE RISK FACTOR**
- Discharge following above management provided parents are happy and will seek advice in 24 hours if no improvement.
- If not admit CSSU.

**GO TO PAGE 2 (BOX 10)**

**GOOD HYDRATION MAINTAINED?**

- Yes
  - Advice to carer, give information leaflet. ORS sachets for home use if substantial losses continue.
  - Carer happy to take child home?
    - Yes
      - Continue management and carer education in HOSPITAL
    - No
      - ADMIT to Short Stay Unit

- No
  - >2 RISK FACTORS
    - Admit to Short Stay Unit for the above management. **Reassess at 4 hours**

**LOW RISK:**
- Age > 6 months and vomits* ≤ 4 per day and stools* ≤ 8/day.

Advice to continue usual fluids at **at least** maintenance and encourage larger volumes. Advise when to return. Give information leaflet.

Additional notes:
- *Count vomits if they are more than an effortless, small volume possett.
- *Count stools if they are a discrete bowel action. Do not underestimate watery stools where a substantial component is absorbed into the nappy.
- Also consider co-morbidity, including short bowel syndrome, ileostomies, CHD, Renal failure etc.

Additional resources:
- Table 5
- Advice when to return
- Carer/doctor concern
- Discharge following above management provided parents are happy and will seek advice in 24 hours if no improvement.
Table 1: Broad differential diagnosis of the child presenting with acute diarrhoea (+/- vomiting). The latter diagnoses are more likely to present chronically.

NB. The following features may be indicative of diagnoses other than acute viral gastroenteritis;
- Abdominal pain with tenderness/guarding and/or bilious vomiting (surgical)
- Pallor, jaundice, oligoanuria, bloody stool (?HUS)
- Systemically unwell, out of proportion to the level of dehydration (other infections, surgical, CAH etc)
- Shock

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infections</td>
<td>Enteral: viral (commonest cause), bacterial, parasitic</td>
</tr>
<tr>
<td></td>
<td>Non enteral infections (UTI, pneumonia, Otitis media)- vomiting predominates</td>
</tr>
<tr>
<td>Surgical</td>
<td>Appendicitis, Intussusception, Obstruction, Short bowel syndrome</td>
</tr>
<tr>
<td>Systemic illness</td>
<td>Endocrinopathy (Diabetes, Hyperthyroidism, Congenital Adrenal Hyperplasia, Addison’s disease, hypoparathyroidism), Immunodeficiency.</td>
</tr>
<tr>
<td>Antibiotic associated</td>
<td>Whilst taking antibiotics and rarely Pseudo-membranous colitis</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Constipation with overflow, Toxins, Haemolytic-uraemic syndrome (HUS), Toddler diarrhoea, Child Abuse (Munchausen by proxy, sexual)</td>
</tr>
<tr>
<td>Dietary disturbance</td>
<td>Food allergy/ intolerance (Lactose, Cows milk protein), starvation stools.</td>
</tr>
<tr>
<td>Malabsorption</td>
<td>Cystic fibrosis, Coeliac disease,</td>
</tr>
<tr>
<td>Inflammation</td>
<td>Ulcerative colitis/ Crohn’s, Hirschsprung’s enterocolitis</td>
</tr>
<tr>
<td>Idiopathic/ Psychogenic</td>
<td>Irritable bowel syndrome</td>
</tr>
</tbody>
</table>

Table 2: Assessment of severity of dehydration (if in doubt err by over-estimating % dehydration).

- Signs are ordered in each column by severity.
- If a pre-illness accurate weight is available calculate deficit from weight loss.
- Pinch test – Pinch skin of abdomen. Skin recoils instantly = normal, 1-2 sec = mild/moderate, >2sec = severe.

<table>
<thead>
<tr>
<th>No dehydration (Less than 3% weight loss)</th>
<th>Mild- Moderate dehydration (3-8% weight loss) Ordered by increasing severity</th>
<th>Severe dehydration (≥9%weight loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No signs</td>
<td>Dry mucous membranes (be wary in the mouth breather)</td>
<td>Increasingly marked signs from the mild-mod. group plus:</td>
</tr>
<tr>
<td></td>
<td>Sunken eyes (and minimal or no tears)</td>
<td>Decreased peripheral perfusion (cool/mottled/pale peripheries, Capillary refill time&gt;2 seconds)</td>
</tr>
<tr>
<td></td>
<td>Diminished skin turgor (Pinch test 1-2 sec)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Altered neurological status (Drowsiness, irritability)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deep (acidotic) breathing</td>
<td></td>
</tr>
</tbody>
</table>

29/07/10
Table 3: Calculation of Oral Rehydration Solution (ORS) requirements in dehydration.

- Mild to Moderate (3% - 8%) dehydration: 30 to 80mls per Kg in 4 hours
- Severe dehydration (>9%): 100mls per Kg in 4 hours

Practical Points:
* Children who are dehydrated are thirsty and do not normally refuse ORS.
* Give fluid little and often. If the child is vomiting decrease volumes and increase frequency (every 5-10 minutes).
* Where carers are not willing/able to do this under supervision (or child is asleep) then rehydrate by NGT.
* Suitable ORS are Dioralyte, Diocalm Junior or Electrolade.

Table 4: Calculation of maintenance requirements.

- 100ml per Kg per 24 hours for the first 10Kg of body weight
- Added to: 50ml/Kg/day for the next 10 Kg of body weight
- Added to: 20ml/Kg/day for remaining Kg of body weight

E.g. A 22Kg child has maintenance requirements of: (10x100)+(10x50)+(2x20)=1,540mls/24hours

Ongoing losses:
These requirements should be supplemented if the child has frequent or substantial watery stools or vomits, by an additional 10ml/Kg per stool/vomit.

Table 5: When to send a stool to the lab for microscopy, culture, sensitivity and virology.

- A history of blood +/- mucous in the stool
- Systemically unwell, severe or prolonged diarrhoea
- If the child is admitted to hospital
- A history suggestive of food poisoning
- Recent travel abroad

Table 6: Management of feeding during gastroenteritis.

- Breast fed: Continue breastfeeding throughout rehydration and maintenance phases
- Formula fed: Restart feed at full strength as soon as rehydration complete (ideally 4 hours)
- Weanled children: Child’s normal fluids and solids following rehydration. Avoid fatty foods or foods high in simple sugars.

Table 7: Guide to drug treatment.

- Antidiarrhoeals: Infants and Children should not be treated with antidiarrhoeal agents.
- Antibiotics: Patients with invasive Salmonella typhi, Shigella, amoebiasis and Giardiasis should be treated with antibiotics. Consider in infants<6months with other salmonellas, those who are systemically unwell and the immunocompromised.
Method of development

A systematic search of electronic databases ‘Medline’, ‘Cochrane’ and ‘Embase’ was performed. Sixty papers were of sufficient quality and relevance to be included in the guideline. Papers were graded according to their strength of evidence. Statements on management were made with a level of recommendation based on the strength of evidence.

In order to develop a consensus based guideline a Delphi method was used. The papers, literature review and statements were sent to a national panel of 40 medical and nursing staff. They were asked to rate their level of agreement with each statement on a 1-9 Likert scale and to comment. Consensus agreement was defined as 83% of panelists rating 7-9. The results were fed back to the panel for further rating and comments twice. The algorithm was developed from the statements that achieved consensus, and where consensus was not achieved, the protocol committee determined local policy.

Evidence for each numbered box on the algorithm

For each of the numbered boxes on the algorithm the literature is discussed. A statement is then made in italics, which was put to the Delphi panel. The level of evidence for the statement and whether it achieved consensus with the panel is reported.

1. Definition of diarrhoea

Diarrhoea is present when there is an increase in the frequency, volume or liquidity of the stool relative to the usual habit of the individual. There is a great variability in stool patterns amongst normal infants. Typically children excrete 5-10 g/Kg per day, but this can vary tremendously. Table 8 shows the range of stool pattern in normal infants. Most papers accept a working definition of diarrhoea as follows:

_Diarrhoea is defined as a change in bowel habit for the individual child resulting in substantially more frequent and/or looser stools._

(Level of evidence Va, recommendation grade D, and Delphi consensus)
2. Differential diagnosis

Once a child has attended Accident and Emergency with a presenting complaint of diarrhoea with or without vomiting we need to know the possible differential diagnoses and the likelihood of these. Unfortunately there is very little data available to help with this clinical question. Conway etal\(^4\) performed a prospective hospital cohort study of patients initially thought to have acute gastro-enteritis and subsequently given other diagnoses. They included patients with vomiting alone. 1,148 were enrolled of which 59(5\%) were found to have other diagnoses, which included infections other than in the GI tract, pyloric stenosis, feeding problems and cows milk protein intolerance.

Fleischer in his textbook of paediatric emergency medicine\(^8\) (Vb,D) gives a differential diagnostic list for children presenting with diarrhoea. In the absence of published evidence a modified list of differentials was sent to the Delphi panel and consensus agreement was achieved on the final table 1, P5 of the algorithm.

*(Level Vb, D and Delphi consensus)*

With respect to life threatening causes of diarrhoea, three studies yield helpful clinical information:

Macdonald and Beattie \(^11\), (Vb,D) carried out a retrospective review of children with intussusception over a 10 year period. Population Incidence was found to be about 1 per 1000 in the first year of life. There were 110 children in whom 32\% had diarrhoea at first presentation. 26\% were shocked or dehydrated, 83\% were vomiting, 32\% had bloody stool. The peak age of diagnosis was 5 months with 80\% under 1. Only 42\% were diagnosed correctly within 3 hours of admission.

Milford etal\(^12\), (III,C) reported on the clinical and epidemiological aspects of HUS in the British Isles (2987-1989), finding cases through the British Paediatric Surveillance Unit and other sources. The overall incidence in children aged 0-15 years was 0.91/100,000. The peak incidence was in the age group 1-2 years at 3.3/100,000/year. 298 children were reported over the three-year surveillance. A prodrome of diarrhoea was present in 273 (95\%) of cases and in 199 it was bloody. Diagnostic features on presentation were pallor in 92\%, jaundice in 35\% and oligo/anuria in 38\%.

Reynolds \(^13\), (Vb,D) looked retrospectively at children presenting with abdominal pain to the A&E department. 371 children were identified over 4 seasonally diverse months. The
final diagnoses were medical in 64.4%, surgical in 6.5% and nonspecific in 29.1%.
Guarding and abdominal tenderness were the two signs most strongly associated with a surgical diagnosis.

The following clinical features should alert the clinician to look for causes other than acute viral gastro-enteritis for a child's diarrhoea +/- vomiting:

- Abdominal pain with tenderness +/- guarding (Vb,D)
- Pallor, jaundice, oligo/anuria, bloody diarrhoea (III,C)
- Systemically unwell, out of proportion to the level of dehydration (Vb,D)
- Shock (Vb,D)

All the above based on Level Vb, D and Delphi consensus agreement.

3. Estimation of severity of dehydration

Weight loss

The severity of dehydration is most accurately assessed in terms of weight loss as a percentage of total body weight (prior to the dehydrating episode). An accurate weight immediately pre-illness is rarely available in the clinical situation, but if it is (for example a recent weight in the parent held record) dehydration can be estimated with some accuracy 14.

Clinical signs

In a prospective cohort study of children between 3 and 18 months of age in Egypt, Duggan 15 (III,C) found that 'prolonged skinfold', dry oral mucosa, sunken eyes and 'altered neurological status' were the best clinical signs correlating with dehydration as determined by post rehydration weight gain. In a similarly designed study, with children <4 years old, Mackenzie etal 16 (III, C) found 'decreased skin turgor', decreased peripheral perfusion and deep (acidotic) breathing to be the best clinical signs. A urea of >6.5mmol/L on serum blood sample and pH<7.35 on blood gas were positive investigations associated with dehydration. However the sensitivity and specificity of all these signs were very low.
In both studies clinical estimates of percentage dehydration greatly overestimated actual dehydration. The textbook estimation of dehydration came originally from the Medical Research Council descriptions in 1952, and was modified by Ironside \(^\text{17}\) in 1970, and more recently by Santosham in 1987 \(^\text{18}\). The percentage weight loses on which they were based were not subject to confirmation in a clinical study. More recently two authors have looked at this. Duggan \(^\text{15}\) (III,C) found that those thought to be mildly dehydrated by Santosham’s scale (Figure 1, p28) showed weight gains of 3.6-3.9%, those moderately dehydrated showed gains of 4.9-5.3% and those severely dehydrated 9.5-9.8%.

Mackenzie \textit{etal} \(^\text{16}\) (III,C) looked only at children who were thought to be moderately dehydrated (7-10% estimated, with one of; diminished skin turgor, sunken eyes, dry mucous membranes, oliguria, recent weight loss). They found weight gains of 3.4-4.0%. These studies need repeating on larger numbers with rigorously defined clinical signs in order to confirm the findings. Nevertheless it is clear that estimation of dehydration may not be accurate.

Capillary refill time $>2$ seconds has been proposed as a useful indicator of dehydration \(^\text{19}\). This sign lacks sensitivity and specificity \(^\text{20}\). Gorelick \textit{etal} \(^\text{21}\) (II,B) showed that in healthy children the capillary refill time was abnormally prolonged following 15 minutes in a cool (air conditioned) room. However, given it’s limitations it is important to note that a child who is severely dehydrated is very unlikely to have a normal capillary refill time. Likewise a prolonged capillary refill in a child with diarrhoea should be taken as a sign of dehydration until proven otherwise \(^\text{14}\).

On the basis of the above studies and WHO guidelines on assessment of the dehydrated child we developed table 2 in the algorithm. Thus children are split into three groups only, namely no dehydration, mild to moderate dehydration and severe. The number and severity of signs present will indicate the degree. This was modified by the Delphi panel and achieved consensus.

\textit{(level III, C and Delphi consensus)}
4. Haematological investigations

No studies have addressed this issue directly. Most episodes of dehydration caused by diarrhoea in developed countries are isonatraemic \textsuperscript{22}. Even when there is derangement of electrolytes in the serum, this is due to \textit{relative} losses of salt and water. There will still be a total body depletion of sodium in hypernatraemic patients \textsuperscript{14}. It is clear from several hospital cohort studies that derangement of electrolytes in acute gastroenteritis in the UK is now rare. Table 9 (p.27) summarizes three recent UK papers looking at hospital cohorts of children with GE. Approximately 1\% of these admissions had hypernatraemia. None of these studies reported hypokalaemia or hyponatraemia, which are commonly found in patients dehydrated with cholera.

Holliday \textsuperscript{23} (II, B) eloquently argues from published evidence that Oral Rehydration Solution with appropriate amounts of solutes and given in the correct quantity is sufficient in itself to correct electrolyte abnormalities (see also Meyers \textsuperscript{24}). It is thus unnecessary to measure electrolytes in those children who will be rehydrated with Oral Rehydration Solution (ORS).

If a child is severely dehydrated with circulatory compromise, they will need rapid Intravenous (IV) infusions to restore circulation and renal perfusion (20ml/kg boluses until circulation restored). Suitable fluids are ringer’s lactate \textsuperscript{23}, or normal saline \textsuperscript{25}. All children having IV rehydration should have a U&E measured, as hypernatraemia will alter the rate at which rehydration fluids are given (discussed below). Further measurements of U&E should be made as rehydration progresses\textsuperscript{14}.

The American Academy of Pediatrics (AAP) suggest in their practice parameter \textsuperscript{22} that Electrolyte levels should be measured in moderately dehydrated children whose histories or physical findings are inconsistent with straightforward diarrhoeal episodes, and in all severely dehydrated children. This is based on a consensus view (Va, D). They also state that clinicians should be aware of the clinical features of hypernatraemic dehydration, namely a doughy feel to the skin +/- irritability and fever. There is no quoted evidence on which this statement is based.
The child who presents with diarrhoea +/- vomiting should have blood taken for urea/creatinine, electrolytes and bicarbonate in the following circumstances:

- Severe dehydration with circulatory compromise
- Moderate dehydration where a ‘doughy’ feel to the skin might indicate hypernatraemia
- Moderately dehydrated children whose histories or physical findings are inconsistent with straightforward diarrhoeal episodes
- When Intravenous rehydration is required. Severe dehydration with circulatory compromise

All the above based on Level Va, D and Delphi consensus.

5. IV Rehydration fluid in severe gastroenteritis

If a child is severely dehydrated with circulatory compromise, they will need rapid IV infusions to restore circulation and renal perfusion (20ml/kg boluses until circulation restored). Suitable fluids are ringers lactate, or normal saline (Vb,D), the compositions of which are given in Table7 (p.29). Once their circulation is stable they will need the remaining estimated deficit to be given over the following 4 hours.

At the time of writing this policy there was controversy over the use of crystalloid versus colloid, which many of the Delphi panelists brought up in their comments. There was no literature on the particular issue of crystalloid versus colloid in the resuscitation of infants and children with diarrhoea. In studies in adults we know that crystalloid is as effective for rapid restoration of circulating fluid volume. Until we have more evidence for children (and this is likely to have to come from a developing country as the numbers of children presenting in shock with diarrhoea are so small in the UK) we will have to use the current literature which does not include a randomised controlled trial on crystalloid versus colloid. Sharifi, Mackenzie and Jenkins all report the use of crystalloid in severe dehydration. No studies report the use of colloid in diarrhoea.

If we look at theoretical issues, the child with dehydrating diarrhoea is different from a child with shock secondary to trauma or sepsis. The dehydrated child has lost water and salts from all body compartments. In severe dehydration the final compartment to decompensate is the intravascular one. The child will have a high haematocrit and will
not have lost any plasma proteins. It thus seems reasonable from a theoretical point of view to restore what has been lost, namely water and salts.

It is argued that if crystalloids are used they diffuse more readily into the interstitial and intracellular compartments. As these compartments are depleted in dehydrating diarrhoea, this seems a theoretically good thing, as long as further fluid is given to maintain intravascular volume.

Children who have severe dehydration with circulatory compromise secondary to acute gastroenteritis should have their circulation restored by rapid iv infusion of ringers lactate or normal saline with a 20ml/kg bolus over one hour (faster if necessary)\textsuperscript{22}. An experienced paediatrician should be involved early. (Level Va, D and consensus)

6. Further boluses

In severe dehydration one bolus may not be sufficient.

A further bolus of 20ml/kg should be given if the circulation is still compromised. If further boluses are required (>40ml/kg) involve an anaesthetist early as intubation and ventilation should be considered (Level Vb,D and consensus).

7. Hypernatraemic dehydration

It is now generally acknowledged\textsuperscript{14,22} following the evidence of several randomised controlled trials in USA, Europe and developing countries\textsuperscript{26,28-30} that ORS is quicker in the correction of dehydration and acidosis and safer than IV therapy. Moreover the use of Oral Rehydration Therapy (ORT) appears to reduce the risk of seizure during correction of hypernatraemic dehydration, Pizarro et al\textsuperscript{31}(Vb,D) reported no seizures among 35 infants with hypernatraemic dehydration whose deficit was repaired with WHO-ORT over 12 hours.

In the largest Randomised Controlled Trial (RCT) of IV versus ORT Sharifi et al\textsuperscript{26}(II,B) randomly assigned 470 children aged 1 to 18 months who were admitted to hospital in Tehran with severe acute GE to receive either ORS (administered initially by Naso-
gastric tube (NGT)) or IV fluid. Of the 34 hypernatraemic patients in the ORT group, 2(6%) developed generalised seizures compared with 6 of 24 (25%) in the intravenous group. Similar results were found by Mackenzie\textsuperscript{27} (II,B) in a study in Australia, the ORS group fairing at least as well as the IV group.

*The child with with hypernatraemic dehydration (Na>150mmol/L) secondary to acute gastro-enteritis should be given slow ORS, aiming to give the estimated deficit over 12 hours. Monitor electrolytes closely\textsuperscript{14,22} (Level Va, D and Delphi consensus).*

8. **Oral versus IV rehydration**

In the child with severe dehydration whose circulation has been restored the above literature suggests that further rehydration should be done with ORS\textsuperscript{14,22,32}.

*Further rehydration can be done orally with ORS (given little and often) if the patient is stable and their mental state allows it. (Level I, A and Delphi consensus)*

9. **Ward management of rehydration**

The overriding principles of the management of gastro-enteritis are rehydration and prevention of dehydration. Several excellent systematic reviews have been published on this subject. The American Paediatric Association\textsuperscript{22} (I,A) and the European Society of Paediatric Gastroenterology and Nutrition\textsuperscript{32,33} (I,A) have both produced practice guidelines concerning management of children with gastro-enteritis, and their main recommendations are based on meta-analysis of good randomised controlled trials. In addition to these there is also a good systematic review published by Murphy\textsuperscript{14} (I,A).

*Composition of ORS*

In the 1970’s the WHO adopted a glucose-electrolyte solution for the treatment of diarrhoea that contained 90mmol/l of sodium. Since then there have been many controlled trials looking at the ideal concentration of electrolytes and carbohydrate in ORS. In developing countries rapid loses of sodium and potassium are documented,
particularly with cholera, nevertheless a recent multicentre trial in 4 developing countries found that reduced osmolarity ORS (224mmol/l) had advantages over standard ORS (311mmol/l) in the treatment of non cholera diarrhoea 34 (II,B). In developed countries diarrhoea tends to be isotonic, and therefore replacement of large quantities of sodium is not so imperative, and indeed may be harmful. Studies from Finland 35 have confirmed that reduced osmolarity ORS is preferable in European children. European Society of Paediatric Gastroenterology And Nutrition (ESPGAN) 32 have published guidelines on the ideal composition of ORS for children of Europe which have taken into account the results of these trials. See table 7 (p.26) for the composition of ORS recommended and those commercially available.

Many papers have been published looking at the different types of carbohydrate to be used in ORS. A recent meta-analysis of 13 clinical trials examining the effect of rice based ORS on total stool output and duration of diarrhoea showed that there appeared to be some benefit in those with cholera, but in those with non-cholera diarrhoea it was uncertain 36(I, A).

ORS used for rehydration of children with acute gastro-enteritis in the UK should contain: 60 mmol/l sodium, 20 mmol/l potassium, not<25 mmol/l chloride and between 74-111 mmol/l glucose.

- Commercial solutions conforming to this include: dioralyte and diocalm Junior.

(Level I,A and Delphi consensus)

Practical points in the administration of ORS

The authoritative reviews previously quoted state that ORS should only be used in the child who is dehydrated. It should be used for rehydration only (i.e. giving the calculated deficit over a 3-4 hour period of rehydration). It may also be used for the replacement of substantial ongoing losses in a child at high risk of dehydration. Page 5 of the algorithm gives some practical pointers for the administration of ORS which were derived from the AAP guideline 22 (level Va, D) and modified by the Delphi Panel:

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Children who have **mild-moderate dehydration** secondary to acute gastro-enteritis should have their deficit estimated (3% to 8%) and replaced with ORS (30-80ml/kg) given ‘little and often’* over 3-4 hours, whenever this is practically possible”. 14 22 32.

*(Level I,A and Delphi consensus)*

*An attempt was made to define little and often further. The literature discusses the correct administration of ORS and recommends that it be given in 5ml aliquots every 1-2 minutes. Only if this is well tolerated with no vomiting the size of the aliquots may be increases with decreasing frequency14 23 24 37 38. However this regime was thought to be too labor intensive for the UK by the Delphi panelists and did not achieve consensus.*

**Definition of Whenever practically possible:**

*Whenever practically possible implies that the child’s carer is willing and able to carry this out under supervision. Where this is not the case (or overnight) rehydrate by continuous naso-gastric tube infusion (preferred) or IVI.*

*(Level Va,D and Delphi consensus).*

Regularly assess success of rehydration (e.g. 2 hourly). If no improvement in clinical signs of dehydration or worsening signs, consider NGT or Intravenous infusion. *(Level Va,D and consensus)*

10. **Urea and Electrolyte investigation in mild to moderate dehydration**

See annotation number 4

11. **Rehydration / maintenance and ongoing losses**

Tables 3 and 4 gives the calculations required for rehydration and maintenance requirements which are well established.

The literature suggests that ongoing losses should be replaced with 10ml/Kg of ORS for each loose stool and substantial vomit14 22 32 (Va,D). However when this was put to the Delphi panel there was no consensus. An alternative of replacing estimated amounts lost was put to the panel but this also did not achieve consensus. Thus this issue had to
be decided locally. Our policy committee decided to recommend replacing losses at 10ml/Kg, which is stated on page 5 of the algorithm.

12. **Failure of ORS**

See annotation number 10

13. **Maintenance of hydration/ prevention of dehydration**

The management of the child who was not dehydrated and the child who is no longer dehydrated following rehydration is similar. It is recommended that these children be allowed free fluids, and should be encouraged to drink more than usual. Standard methods for calculating maintenance requirements are shown in Table 4, page 5 of algorithm

> To prevent primary dehydration or recurrence of dehydration allow unrestricted fluids (eg milk or water). Ensure that at least maintenance fluids are taken.

*(Level Va,D and Delphi consensus)*

14. **Re-feeding following rehydration**

Historically children were starved for the period of rehydration (often over 24 hours) and were then re-graded onto increasing strengths of milk feed. This was not based on any evidence, but thought to reduce the incidence of lactose intolerance. Many trials now suggest that rapid introduction of feeding following rehydration reduces the duration of illness and the number of loose stools, as well as improving nutrition. Brown performed a meta-analysis of the use of non-human milks in gastro-enteritis and concluded that the vast majority (over 80%) of young children with acute diarrhoea can be successfully managed with continued feeding of undiluted non-human milks *(I, A).* This is now recommended practice, including the introduction of age appropriate diets in children who are weaned.

Good evidence exists to show that children who are breast fed should continue breast feeding throughout the rehydration and maintenance phases of their therapy *(III,C).* In so doing they reduce the risk of dehydration, pass smaller volumes of stool and recover quicker.
Breast feeding children should continue to breast feed through the rehydration and maintenance phases of their acute gastro-enteritis illness.

(Level III,C and Delphi consensus)

In the dehydrated child with gastro-enteritis who is normally formula fed, feeds should stop during rehydration and restart as soon as the child is rehydrated (4 hours)

(Level I, A and Delphi consensus)

These principles are stated in table 6 page 5 of the algorithm.

15. Information

No evidence was found concerning the interests of other stakeholders, namely parents, carers and the children themselves in the management of acute gastroenteritis. It would be interesting to know what their views are about the use of oral rehydration therapy, intravenous infusions, naso-gastric tubes and care in hospital or at home. No evidence on which to base a statement is currently available.

At a basic level, however, parents or carers should always be discharged with written information concerning the home management of diarrhoea +/- vomiting. The information sheet that we use is shown in appendix 2, and was developed from comments made by the Delphi panelists.

Parents / carers should be given a good information sheet concerning the home management of diarrhoea +/- vomiting on discharge home.

(No literature, Delphi consensus)

16. Admission criteria

See annotation number 19

17. Risk of dehydration

If a child is at high risk of becoming dehydrated, even though they are not dehydrated at the time of being seen in A&E they need to be managed differently to the child who is
very unlikely to become dehydrated. The following factors were noted in the literature to increase the risk:

**Age of the child**

From first principles it seems reasonable that the young infant would be at higher risk of dehydration than the older child. They have increased insensible losses due to their surface area:volume ratio, they have an inherent tendency to more severe vomiting and diarrhoea, and their prime source of nutrition is milk which has a high osmotic load. This theory is born out by studies in India and Brazil. Bhattacharya *et al* 42 (III,C) found a non significant trend towards the younger age groups being at more risk, Fuch *et al* 43 (III,C) found a definite association, with young infants (<9 months and especially 2-3 months) at greatest risk of dehydrating diarrhoea.

**Severity of symptoms**

It seems reasonable to assume that the severity of the symptoms would affect risk of dehydration. Bhattacharya 42 (III,C) in Calcutta performed a prospective case-control study. 379 infants<2 years old were enrolled on presentation with diarrhoea of <24 hours (defined as >3 loose stools in 24 hours). They were interviewed and assessed independently. The infants were then categorised as moderate/severe dehydration (cases) versus mild dehydration (controls), and risk factors compared. The most significant were withdrawal of breast feeding and not giving extra fluids. Additional factors were age<12months, stool frequency >8/day, vomits>2/day, vibrios in stool and malnutrition. Faruque 40 (III,C) had very similar results in an almost identical trial design of 1,013 infants 1-35 months in Bangladesh. They found the same risk factors for dehydration as Bhattacharya (age<6 months, stool>11 per day, history of vomiting) and in addition lack of maternal education.

Fuchs *et al* 43 (III, C) in a case control study in Brazil found that those who were formula fed, or who had been recently weaned from the breast were at highest risk of developing moderate to severe dehydration, independent of confounding variables.

Unfortunately risk factors for dehydration have not been looked at in developed countries, and the above findings may not be directly applicable to the UK. In particular
vomiting>2times/day does not seem to equate with a high risk of dehydration in our clinical practice. In the UK rotavirus is very common and often causes frequent vomiting as the first sign of illness, without necessarily increasing the risk of dehydration. In view of there being no literature on risk in a developed country the Delphi panel were asked for their views on factors putting the child at greater risk.

The following factors in the history of a child presenting with diarrhoea should alert the clinician to a high risk of dehydration:

- Infants <6 months (Level III, C and Delphi consensus)
- More than 8 significant* diarrhoeal stools in the last 24 hours.

*A significant stool is a discrete bowel action. Diarrhoea as defined in statement 1. Take care not to underestimate watery stools where a substantial component has been absorbed into the nappy.

(Level III, C and Delphi consensus)

More than 4 significant* vomits associated with diarrhoea in the last 24 hours.

- A 'significant' vomit is anything more than an effortless, small volume, possett.

(Level III, C and Delphi consensus)

The panel also considered including infants recently weaned off the breast, but felt that this did not seem relevant to our practice in a developed country. Consensus disagreement.

18. Replacement of losses in the child at risk of dehydration.

There are no trials concerning this issue, but the AAP practice parameter and Murphy’s review recommend that ongoing losses for the infant at high risk of dehydration should be replaced with 10ml/Kg of ORS for each loose stool and substantial vomit14 22 32(Va,D). However, the Delphi panel did not agree with this point. An alternative of replacing the estimated volume lost was put to the panel but this also did not achieve consensus. In view of the lack of consensus and no evidence in the literature either way, this issue will have to be decided at a local level. Our policy committee agreed with replacing losses at 10ml/Kg per substantial stool/vomit.
19. Criteria for admission of children with gastroenteritis

Despite the number of practice parameters and reviews of the literature, there are no recommendations as to when a child should be admitted to hospital. Several authors have queried the appropriateness of admission in some cases. It is clear that the child with severe dehydration must be admitted. Children with moderate dehydration and those at high risk of developing dehydration will need to be watched carefully. Those moderately dehydrated should be observed frequently by medical staff until they are fully rehydrated, and those at risk of dehydration will need to be observed for a period to ensure that they remain well hydrated. (No literature evidence)

Clearly in cases where there is diagnostic uncertainty children may need admission for investigation or observation of the progress of their illness.

We know that there are many influences on a doctor’s decision to admit a patient other than their medical condition. Fitzgerald found that for the same severity of acute gastroenteritis, children with mothers reporting higher levels of psychological distress were more likely to be admitted. These mothers were also likely to have poor social resources. These factors influencing admission are less easy to define, but are equally important and should be incorporated into a practice guideline.

- Children presenting to hospital with acute gastro-enteritis who are severely dehydrated should be admitted to hospital.
- Those children with mild/moderate dehydration should be observed in a hospital paediatric facility for a period of at least 6 hours to ensure successful rehydration (3-4 hours) and maintenance of hydration (2-3 hours).
- Those children at high risk of dehydration on the basis of young age, high frequency of watery stools or vomits, should be observed in a hospital paediatric facility for at least 4-6 hours to ensure adequate maintenance of hydration.
- Those children whose parents or carers are thought to be unable to manage the child’s condition at home successfully should be admitted to hospital.

(All the above Level Vb, D and Delphi consensus)
20. Admission criteria

See annotation number 20

21. Literature concerning the need for stool culture

Diagnosis & treatment

Once a diagnosis of acute gastro-enteritis has been made clinically, the question of the aetiology of the infection arises. For the individual, it would be important to know what is causing the symptoms if treatment of the infection could eliminate them. As we shall discuss later on, treatment is rarely necessary and therefore stool culture for this reason alone is not productive.

Prognosis

Some might argue that we would have a clearer idea of the prognosis if we knew the aetiology. With respect to acute risk of dehydration this does not seem to be the case. The risk of dehydration was the same for all aetiologic agents except cholera in both Faruque40 (III,C) and Bhattacharya’s 42 studies (III,C). Fortunately in the UK cholera is only seen rarely in children who have travelled abroad. With respect to predicting which infections are likely to become chronic, it may be useful to know the pathogen. However when a child presents acutely it is unnecessary to make this distinction. If they present with diarrhoea lasting 5 or more days, a stool sample can be taken at this point.

In the UK a history of travelling abroad must be taken seriously. There have been two case series reported in the literature of children with malnutrition and severe chronic diarrhoea treated in UK hospitals following an extended trip abroad 47 48 (Vb,D). A history of foreign travel therefore is a good reason to check a stool culture.

Implications of aetiology for Public Health

From a public health point of view it is clearly important to know which organisms in the community are causing infections, and more specifically whether there is any evidence of outbreaks of disease. With respect to food poisoning (Shigella, salmonella, campylobacter) it is important that the source of any outbreak is traced and dealt with.

Thus it is clear from the public health point of view that some stool samples should be sent for culture. However if all patients with a short spell of diarrhoea had a stool sample
sent to the laboratory for culture the lab would be overwhelmed. It therefore seems reasonable to try to limit stool specimens sent to those likely to have important (bacterial or parasitic) infections.

**Important historical features**

DeWitt et al\textsuperscript{49} (III,C) looked at the value of various features of history and examination and stool screening tests in predicting whether diarrhoea was caused by a bacterial agent. They studied 200 children less than 4 years old presenting to a primary care centre in the USA with diarrhoea of less than 10 days. The best predictor on clinical grounds alone was a cluster of 3 historical variables- abrupt onset of diarrhoea, more than 4 stools per day and no vomiting before the onset of diarrhoea. This cluster had a sensitivity of 86% a specificity of 60%, PPV of 27% and NPV of 96%.

Diarrhoea which is frankly bloody is more likely to be caused by invasive bacteria than viruses. Finkelstein et al\textsuperscript{50} (III,C) found that in 1,035 infants under 1 year of life with diarrhoea (of which 108 (10.4%) had a bacterial cause), a history of blood in the stool was the best individual predictor of bacterial infection (sensitivity 39%, specificity 88%, PPV 30%, NPV 92%). Temperature >39°C and >10 stools per day were also useful indicators. Conway\textsuperscript{4} (Vb, D) looked at 1148 children <16 years with diarrhoea, in whom 153 (13%) had bacterial, protozoal or mixed pathogen aetiology. They found that the bacterial group had a statistically significant higher stool frequency of >7 per day, but the difference was of little use to the clinician (36% in bacterial group and 26% in rotavirus group, no figures given to calculate sensitivity etc). They also found that the stool more frequently contained blood or mucus (25% in the bacterial group compared with 2.8% in the viral group). In Milford’s study of HUS\textsuperscript{12} (III,C), 199 children (73%) had a prodrome of bloody diarrhoea, with 178 of these growing coliforms in the stool.

Based on these studies Table 5 on page 5 of the algorithm was developed. Each statement is based on different levels of evidence as follows:

- A history of blood +/- mucus in the stool (Level III,C and Delphi consensus)
- Systemically unwell, severe or prolonged diarrhoea (no literature, Delphi consensus)
- If the child is admitted to hospital (no literature AND no Delphi consensus, this was decided by local policy)
- A history suggestive of food poisoning (no literature, Delphi consensus)
• Recent travel abroad (Level Vb, D and Delphi consensus)
• Abrupt onset of diarrhoea with more than 4 stools per day and no vomiting pre-diarrhoea (Level III, C BUT no Delphi consensus thus our local protocol committee decided not to include this).

22. Role of medication in gastroenteritis

Anti-diarrhoeal/anti-motility agents

Several trials looking at the use of these agents have been reported. They are thoroughly reviewed in the AAP practice parameter 22 and Murphy’s systematic review14. On the strength of the evidence and consensus opinion it is strongly recommended that these agents are not used in the treatment of diarrhoea in children.

Infants and children with acute gastro-enteritis should not be treated with anti-diarrhoeal agents.

(Level 1, A and Delphi consensus)

Anti-microbial agents

There are several trials reported in the literature investigating the treatment of Campylobacter jejuni. Murphy14 reports that one randomised controlled trial indicated that if erythromycin was started at first presentation before the results of the stool culture were available, the clinical course of the illness was shortened. Other randomised trials in which erythromycin was started after isolation of the organism showed a shortened period of bacterial excretion, but no effect on the clinical course of the illness (I, A). Trials investigating the antibiotic treatment of Yersinia enterocolitica and E coli. have not found any benefit.

Invasive Salmonella typhi (i.e. a systemic infection featuring malaise, meningismus, and fever) clearly needs treatment and sensitivities are required. For other salmonella infections there is no evidence that anti-microbials help51 (III, C), although they should be considered in young infants, immunocompromised children, and those who are systemically unwell. Anti-microbial treatment is however worthwhile in Shigella, Amoebiasis and Giardiasis14 (Vb, D).
Patients with invasive *Salmonella* typhi, *Shigella*, amoebiasis and *Giardia* should be treated with antibiotics. (Level III, C and Delphi consensus)

Suggested antibiotics according to the British Medical Formulary:

- *Salmonella* typhi – ciprofloxacin until sensitivities available
- *Shigella* – trimethoprim (or ciprofloxacin for trimethoprim-resistant strains)
- *Giardia* – metronidazole
- *Amoebiasis* – metronidazole and Diloxanide furoate.

Consider treatment of *Salmonellas* other than *S. Typhi* in infants <6 months, those who are systemically unwell and the immunocompromised.

(Level Vb, D and Delphi consensus)
Table 8: Normal infant stool patterns, from Baldessano, 1991¹⁰.

<table>
<thead>
<tr>
<th>Age and feed type</th>
<th>Stool pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 months, Breast fed</td>
<td>Very wide range of once every 2-3 weeks to about 12 times per day; yellow to light brown; pH=5.0</td>
</tr>
<tr>
<td>0-6 months, Formula fed</td>
<td>1 to 3 per day (range 1-7); yellow to brown; formed; pH=7.0</td>
</tr>
<tr>
<td>6 months – 1 year</td>
<td>2-3 per day (range 1-7); brown; formed</td>
</tr>
<tr>
<td>After 1 year</td>
<td>Formed; like adult stool</td>
</tr>
</tbody>
</table>
### Table 9: Frequency of deranged electrolytes in acute gastroenteritis in developed countries.

<table>
<thead>
<tr>
<th></th>
<th>Jenkins⁵ Cohort of GE in South Wales, 1987/8, children &lt;16 years</th>
<th>Conway⁴, Cohort of GE in Leeds, 1986/7, Children &lt;16 years</th>
<th>Ellis⁶ Cohort of GE in Manchester, 1982 (Infectious dis Unit) Infants &lt;2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of cases</td>
<td>215</td>
<td>1148</td>
<td>447</td>
</tr>
<tr>
<td>No. (%) moderate-severe dehydration (5-10%)</td>
<td>15 (7%)</td>
<td>12 (1%)</td>
<td>63 (14%)</td>
</tr>
<tr>
<td>No. in whom electrolytes were measured</td>
<td>76 (35%)</td>
<td>1119 (97%)</td>
<td>NR</td>
</tr>
</tbody>
</table>
| Hypernatremia (as defined in each study in mmol/l) | Na >145
2 (<1%) | Na >149
8 (<1%) | Na>150
5 (1%) |
| Urea (mmol/l)    | Urea >6
17 (8%)                                                      | Urea >7
86 (7%)                                                      | Urea >6
8 (1.8%)                                                        |
| Bicarbonate <15mmol/l | 13 (6%)                                                      | NR                                                          | 3 (<1%)                                                           |

NR= Not reported.
Table 10: Composition of fluids for intravenous and oral rehydration.

<table>
<thead>
<tr>
<th>Oral</th>
<th>Osmolality mOsm/L</th>
<th>Glucose mmol/L</th>
<th>Na mmol/L</th>
<th>Chloride mmol/L</th>
<th>Potassium mmol/L</th>
<th>Base mmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESPGAN</td>
<td>200-250</td>
<td>74-111</td>
<td>60</td>
<td>Not&lt;25</td>
<td>20</td>
<td>Citrate 10</td>
</tr>
<tr>
<td>Dioralyte</td>
<td>240</td>
<td>90</td>
<td>60</td>
<td>60</td>
<td>20</td>
<td>Citrate 10</td>
</tr>
<tr>
<td>Diocalm Jr</td>
<td>251</td>
<td>111</td>
<td>60</td>
<td>50</td>
<td>20</td>
<td>Citrate 10</td>
</tr>
<tr>
<td>Rehidrat</td>
<td>335</td>
<td>91*</td>
<td>50</td>
<td>50</td>
<td>20</td>
<td>Bicarb 20</td>
</tr>
<tr>
<td>Electrolade</td>
<td>251</td>
<td>111</td>
<td>50</td>
<td>40</td>
<td>20</td>
<td>Bicarb 30</td>
</tr>
<tr>
<td>WHO ORS</td>
<td>330</td>
<td>111</td>
<td>90</td>
<td>80</td>
<td>20</td>
<td>Citrate 10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intravenous</th>
<th>Ringers</th>
<th>Lactate</th>
<th>Osmolality mOsm/L</th>
<th>Glucose mmol/L</th>
<th>Na mmol/L</th>
<th>Chloride mmol/L</th>
<th>Potassium mmol/L</th>
<th>Base mmol/L</th>
</tr>
</thead>
</table>
| 0.9% saline | ... | 154 | 308 | ... | 154 | ... | ... | ...

*Glucose given with fructose 1mmol/L and sucrose 94mmol/L
References


## Appendix 1

### Article Grading

#### Levels of evidence, as suggested by Muir Gray¹

<table>
<thead>
<tr>
<th>Type</th>
<th>Strength of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Strong evidence from at least one systematic review of multiple well-designed randomised controlled trials</td>
</tr>
<tr>
<td>II</td>
<td>Strong evidence from at least one properly designed randomised controlled trial of appropriate size. Positive when the lower limit of the confidence interval for the effect of treatment/intervention exceeds the clinically significant benefit.</td>
</tr>
<tr>
<td>III</td>
<td>Evidence from well-designed trials without randomisation, single group pre-post, cohort, time series or matched case-control studies</td>
</tr>
<tr>
<td>IV</td>
<td>Evidence from well-designed non-experimental studies from more than one centre or research group</td>
</tr>
<tr>
<td>V</td>
<td>Opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees</td>
</tr>
</tbody>
</table>

We have decided to add a category to this classification, namely Va for opinions of respected bodies, Vb for other evidence in the level V category.

### Suggested grading based on Cook²

Grade A, supported by level I evidence and therefore highly recommended.

Grade B, supported by level II evidence, and therefore recommended.

Grade C, supported by level III, evidence. Several potential clinical actions might be considered appropriate.

Grade D, supported by level IV and V evidence. The consensus route would have to be adopted.

### References
