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Clinical management of diarrhoea in children

Harry Poka[1] and Trevor Duke[2]

Kundiawa Hospital, Papua New Guinea, Centre for International Child Health, University of Melbourne, Australia and School of Medicine and Health Sciences, University of Papua New Guinea

SUMMARY

Diarrhoea is one of the commonest reasons children require health care in Papua New Guinea (PNG). Acute watery diarrhoea is the commonest form, and is due to viruses. Oral rehydration solution, zinc and continued breastfeeding are highly effective treatments that can be delivered in homes and health facilities. Antibiotics are not useful in acute watery diarrhoea – they make it worse. Deaths from acute watery diarrhoea should be rare if basic curative services are available. Persistent diarrhoea (lasting longer than 14 days) is commonly associated with other co-morbidities, including malnutrition, anaemia, HIV (human immunodeficiency virus) infection, parasite (such as *Giardia*) or worm infections and environmental enteropathy. Educating parents on handwashing, food preparation, water purification, improvements in sanitation and the home environment, breastfeeding, nutrition and immunization are essential in preventing diarrhoea. Cholera appeared in PNG in 2009, causing over 500 deaths in all age groups. Cholera emerged because of limited access to safe, clean drinking water and poor sanitation. Addressing these will have beneficial effects not only on cholera but also on all causes of diarrhoea and many other common childhood infections.

Introduction

Diarrhoea is one of the commonest causes of morbidity and mortality in low- to middle-income countries, accounting for 11-16% of the 6-7 million deaths annually in 2010-2011 (1,2). Diarrhoea is consistently in the top 3 or 4 causes of hospital admissions in Papua New Guinea (PNG), and is among the commonest causes of death in hospitalized children, after neonatal conditions, pneumonia, malnutrition, meningitis and tuberculosis (3). In PNG hospitals in 2010-2012 the case fatality rate from diarrhoea was 2.7-3.4%. Case fatality rates will be higher in remote communities where access to basic treatment is limited.

Complications

The two main results of diarrhoea are dehydration and malnutrition. The management of diarrhoea is predominantly the management of the dehydration, but sometimes also management of the cause of the diarrhoea, and the metabolic imbalances that arise with dehydration. Management of diarrhoea requires that the health worker distinguish between acute watery diarrhoea, acute dysentery and persistent diarrhoea (4,5). Management of diarrhoea often also includes managing co-morbidity, such as undernutrition or anaemia.

Social context and preventive measures

Health workers looking after children with diarrhoea should not just provide treatment, but also focus on prevention and the low-cost public health measures that can reduce deaths from diarrhoea. Socioeconomic issues, including inappropriate feeding and environmental enteropathy (6) among

1 Kundiawa Hospital, PO Box 346, Kundiawa, Simbu Province, Papua New Guinea

2 Centre for International Child Health, University of Melbourne, Royal Children's Hospital, Parkville, Victoria 3052, Australia and School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, National Capital District, Papua New Guinea
Corresponding author
trevor.duke@rch.org.au

children living in impoverished conditions, need to be addressed to effectively manage some children with diarrhoea, particularly that which is recurrent or persistent or associated with malnutrition. Diarrhoea can be prevented by breastfeeding and adequate nutrition, handwashing with soap, clean toileting and sanitation measures, improved drinking water supply (such as with chlorination or water filters), vitamin A supplementation, measles vaccination and, in countries where this is available, rotavirus vaccine (2,7).

Despite preventive measures episodes of acute watery diarrhoea will still occur. However, deaths from acute watery diarrhoea should be very rare. If a child dies from acute watery diarrhoea this usually means they did not get access to oral rehydration solution (ORS). A well-nourished child who is breastfed and who receives ORS when they develop watery diarrhoea will almost always recover. Most deaths from diarrhoea represent a failure of basic preventive and curative health.

Classification and causes of diarrhoea

Diarrhoeal diseases are classified as acute watery diarrhoea, bloody diarrhoea or dysentery and persistent diarrhoea (4,5). Acute watery diarrhoea is the passage of 3 or more loose or watery stools in a 24-hour period. It is the loose and watery consistency of the stools that defines diarrhoea, not the frequency. Acute diarrhoea lasts for less than 14 days. Persistent diarrhoea is that which lasts for 14 days or more. Viruses cause approximately 70% of all diarrhoea, with rotavirus causing a third of the acute watery diarrhoea in the developing world, including in PNG (8,9). *Shigella* spp. are the commonest cause of dysentery. Other causes of diarrhoea include enterotoxigenic *Escherichia coli*, *Cryptosporidium*, *Salmonella* species, *Aeromonas* species, *Vibrio cholerae*, *Campylobacter jejuni* and *Entamoeba histolytica* (2). Among children who develop diarrhoea, simple acute watery diarrhoea is the most common clinical syndrome. However, children can have both acute watery diarrhoea and dysentery, or persistent diarrhoea and dysentery. Common causes of persistent diarrhoea associated with malnutrition in PNG include HIV (human immunodeficiency virus) and environmental enteropathy (10).

Systemic illnesses causing diarrhoea are often not considered in the diagnosis of diarrhoea. Systemic illness such as generalized sepsis, urinary tract infection, typhoid and malaria may also be associated with diarrhoea, with or without vomiting, especially in infants. Generalized viral infections, such as with enterovirus, adenovirus or coxsackie virus, causing respiratory infection and diarrhoea are relatively common, although no specific laboratory diagnostic tests are available in PNG. The management, however, is the same: treat the dehydration and manage complications. There are important surgical causes of diarrhoea including acute appendicitis, intussusception and, in the PNG highlands, pigbel (enteritis necroticans).

With the high prevalence of HIV infection in the PNG community, children presenting with recurrent diarrhoea, especially with other recurrent infections, oral thrush or malnutrition, should be screened for HIV (11).

Issues to consider in the management of diarrhoea

The management of diarrhoea in most cases requires health workers to identify and classify diarrhoea and follow clinical treatment algorithms. The major decisions must address the following questions. How dehydrated is the child? How much fluid to give? By which route should fluid be given? How frequent? What fluid to use? Is the child safe to be managed as an outpatient? Are antibiotics needed? In PNG, laboratory services such as culture and antibiotic susceptibility, liver and renal function tests and blood gas measurement are limited or unavailable in many hospitals, and virtually never available at health centres. This can make the problems of differentiating simple diarrhoeal illness from systemic illness causing diarrhoea difficult, and make it difficult to identify children with severe electrolyte imbalance from diarrhoea and dehydration. However, the vast majority of children with diarrhoea can be managed using treatment algorithms based on clinical signs, without laboratory tests, and this approach has saved countless thousands of lives. Beyond decisions about fluid replacement, other management includes: continued breastfeeding, which reduces the duration and severity of diarrhoea and reduces the nutritional consequences of an episode of diarrhoea; other foods which can reduce diarrhoea (such as green bananas) (12); and giving zinc sulphate to all children

with acute or persistent diarrhoea (13-16).

Correction of dehydration

The identification of the degree of dehydration requires eliciting simple clinical signs, an estimation of body weight loss, and an understanding of the relationship between weight change and body water loss: ie, that 500 mg of weight loss is equivalent to 500 ml of body water lost, and that a 10 kg child is 10,000 ml, so a 500 mg weight loss = 5% dehydration. This can be complicated for health workers to calculate, and accurate premorbid weights are not always available, so treatment algorithms based on simple clinical signs are used by all health workers. Fluid rehydration is therefore based on the degree of dehydration (Table 1).

No single clinical feature will accurately identify the degree of dehydration, and some clinical signs (such as loose skin pinch) are confounded in malnutrition (ie, the child with marasmus will have loose skin pinch because of subcutaneous fat and muscle loss, but may not be dehydrated). So dehydration is often overestimated in marasmus. Combinations of clinical features are used together with the clinical context. The most useful signs for predicting dehydration are the respiratory pattern, the capillary refill time and the skin turgor (17).

Fluid therapy in dehydration requires replacing (a) the fluid deficit, (b) the normal maintenance fluids and (c) any ongoing losses. The final fluid rate used for rehydration is calculated in Table 2.

Hydration is often restored over a 12-hour period, but some studies have shown it is possible to rehydrate over 4-6 hours. The World Health Organization (WHO) and

TABLE 1

Bed-side assessment of dehydration in a child with diarrhoea

Degree of dehydration	Mild	Moderate	Severe
Clinical signs/ symptoms	• Thirsty with normal skin	• Dry mucous membrane with reduced or no tears • Increased respiration • Poor skin turgor (slow skin pinch) • Delayed capillary refill (2-4 sec)	• Floppy • Lethargic • Increased and deep respiration Very poor skin turgor (very slow skin pinch) • Very prolonged capillary refill
Approximate percentage of body weight dehydrated (%)	<5	5-10	>10
Approximate fluid deficit	50 ml/kg	75 ml/kg	100 ml/kg

Note:
The World Health Organization (WHO) and Integrated Management of Childhood Illness (IMCI) have simplified the degree of dehydration as some dehydration (moderate dehydration, which is 5-10% of body weight dehydrated) and severe dehydration (severe dehydration, which is >10% of body weight dehydrated)

TABLE 2

CALCULATION OF THE RATE OF FLUID ADMINISTRATION FOR REHYDRATION*

Fluid deficit	Maintenance fluid	Ongoing losses
Degree of dehydration with its corresponding percentages multiplied by the current weight (% x weight in grams)	1st 10 kg = 4 ml/kg/hour 2nd 10 kg = 2 ml/kg/hour Weight after 20 kg = 1 ml/kg/hour Calculate maintenance fluid rate per hour	Losses such as - Vomiting - Diarrhoea - Nasogastric tube aspirates Estimate ongoing fluid loss Usual estimate is 50-100 ml per diarrhoeal stool

Final fluid volume to be given = [% x weight in grams] + [Maintenance fluid rate] + [Estimate of ongoing fluid loss]. Give fluid volume over 12 hours.

*See reference 4

Integrated Management of Childhood Illness (IMCI) recommend the rehydration of a child with severe dehydration over 6 hours (4).

Oral rehydration salt is the cornerstone of rehydration. ORS is based on the principle that sodium absorption in the small intestine is linked to glucose absorption. To enable the optimum absorption of sodium, glucose and water, the concentrations must be in the range recommended for ORS (18). ORS is generally given by mouth (give a cup to the mother or father) or, for the child who cannot take oral fluids, by nasogastric tube.

For severe dehydration or shock fluid can be given intravenously, usually with half-strength Darrow's solution or Hartmann's solution (Ringer's lactate). When the child is in shock, 0.9% sodium chloride ('normal saline') or Hartmann's solution is used to restore the poor circulation with a bolus dose of 10 ml/kg or 20 ml/kg of body weight before calibrating the fluid rate over 12 hours (4). The critical factor is to continually reassess the rehydration of the child and adjust the fluid rate as necessary. Persisting under-hydration even after a child is admitted to a hospital or health facility is a common problem, especially where there is poor staffing and monitoring of patients. The resolution of clinical signs of dehydration must be frequently assessed by health workers in the first 24 hours of treatment.

With limited or no biochemical analyses to assist the clinical process of assessment, hyponatraemic or hypernatraemic dehydration is difficult to identify. In this context rehydration over a 12-hour period is safe and protects against rehydrating too fast, which can sometimes exacerbate the effect of severe sodium derangement. Hypokalaemia, a common biochemical complication in diarrhoea and vomiting, sometimes leading to weakness or paralytic ileus, is also difficult to diagnose without laboratory tests. However, ORS contains 20 mmol/l (1.5 g/l) of potassium chloride, so empirical use of ORS addresses this issue in most children.

Are antibiotics needed?

Antibiotics are overused in the management of diarrhoea. Antibiotics are virtually never required for acute watery diarrhoea. There is no place for antibiotics in diarrhoea caused by viruses. An antibiotic is only indicated for bloody diarrhoea and persistent diarrhoea. Specific antibiotics are prescribed for the systemic infections that cause diarrhoea.

The current recommended treatment for dysentery is ciprofloxacin to treat *Shigella*

spp. and tinidazole to treat *Entamoeba histolytica*. *Shigella flexneri* is the most common bacterium causing bacillary dysentery in PNG. *S. flexneri* multidrug resistance is not new in PNG, but now there is very-high-level resistance towards amoxycillin (98% resistant), chloramphenicol (63% resistant, 28% intermediate susceptibility) and cotrimoxazole (86% resistant) (19). Ciprofloxacin and cephalexin maintain in vitro efficacy. Ciprofloxacin should be prescribed and specifically used only for severe dysentery, *not* for other diarrhoeal diseases (5,20). Recently ciprofloxacin has been increasingly and appropriately used to treat children with typhoid, and also often for osteomyelitis. More than 90% of the staphylococci isolated in patients with osteomyelitis in Kundiawa Hospital are resistant to flucloxacillin and chloramphenicol, while retaining full susceptibility to ciprofloxacin (unpublished data from Kundiawa General Hospital Surgical Department). However, the overuse of ciprofloxacin will increase resistance among Gram-negative bacilli.

Giardiasis is a common cause for persistent diarrhoea in children and tinidazole is the antibiotic of choice. Diarrhoea in seriously ill neonates can be caused by bacteraemia, and rates of death are highest in dysentery in young infants, often due to *E. coli*. Febrile or very unwell young infants with diarrhoea should receive antibiotics to treat Gram-negative sepsis.

Cholera is caused by infection with the bacterium *Vibrio cholerae.* About 20% of those who are infected develop acute watery diarrhoea. Cholera with severe dehydration should be treated with IV (intravenous) fluid, ORS, antibiotics and zinc sulphate. Antibiotics in cholera shorten the duration of illness, decrease faecal excretion of vibrios, decrease the volume of diarrhoea and reduce fluid requirements during rehydration (21). Single-dose doxycycline increases compliance; an alternative is erythromycin (4 times per day for 3 days) (21).

Other therapies

Continued breastfeeding reduces the duration and severity of diarrhoea and reduces complications such as malnutrition (8,22). In some babies with prolonged diarrhoea, lactose intolerance may be a problem, but this is rare in breastfed babies. In non-breastfed children a lactose-free diet will reduce symptoms. Children with persistent diarrhoea are prone to develop malnutrition (23) and feeding must be encouraged and maintained.

Zinc sulphate is effective in reducing the severity and duration of acute diarrhoea (14,22), reducing the severity of cholera (24), decreasing mortality and improving weight gain among children with severe malnutrition (25), preventing diarrhoea if given to low-birthweight babies (26), and reducing the severity and duration of dysentery (bloody diarrhoea) from *Shigella* (27). If given for 10-14 days to children with diarrhoea zinc shortens the length of time the child is sick *and* reduces the chance of diarrhoea developing in the next 2-4 months. Therefore, even when given as *treatment* in hospital or health centre, zinc has an important longer-acting *preventive* effect.

Parental education and improving the home environment

Educating parents on handwashing, food preparation, water purification and improvements in sanitation and the home environment, including breastfeeding and immunization, are essential in preventing diarrhoea (8,23).

Conclusion

Oral rehydration solution is the most important therapy in managing children with diarrhoea. It is cheap, highly effective and saves thousands of lives. Child deaths from watery diarrhoea usually only occur if a child is not given adequate volumes of ORS. Antibiotics are overused in diarrhoea treatment, and are only indicated for dysentery and cholera. Low-cost measures can stop child deaths from diarrhoea. These include breastfeeding, handwashing with soap, improved drinking water, community-wide sanitation, measles and rotavirus vaccines, vitamin A and zinc.

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