

Diarrheal illnesses and rehydration methods



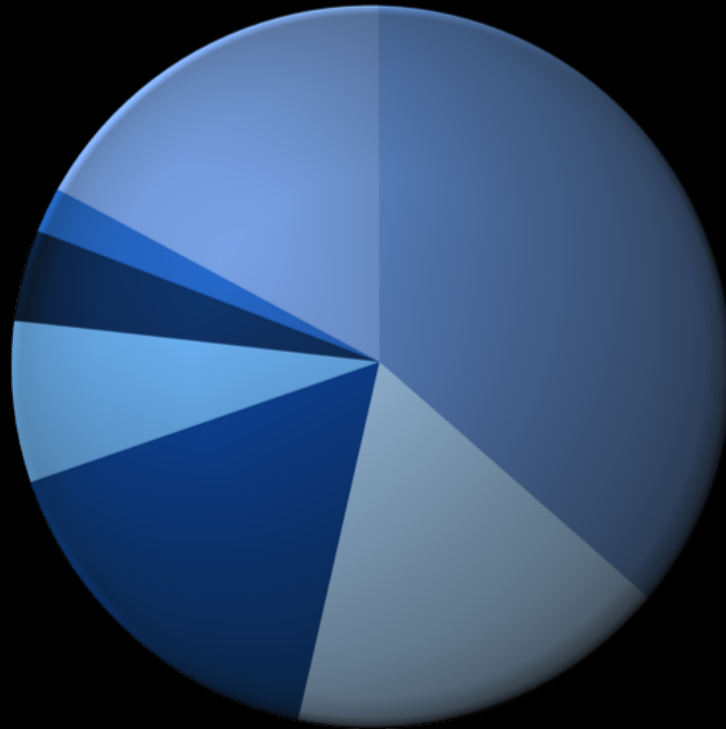
Photo by Brett Nelson. No permission needed.

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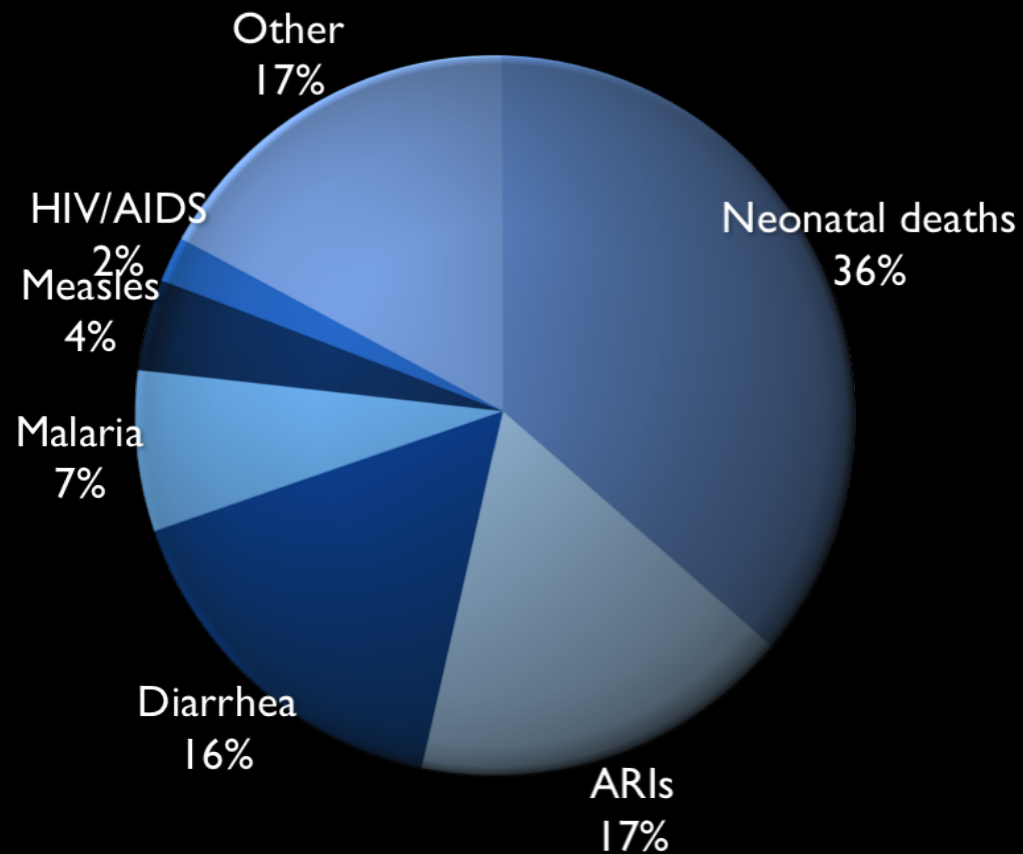
Discussion outline

- Scope
- Etiology
- Diagnosis and management
- Practica:
 - Mixing ORS, using MUAC

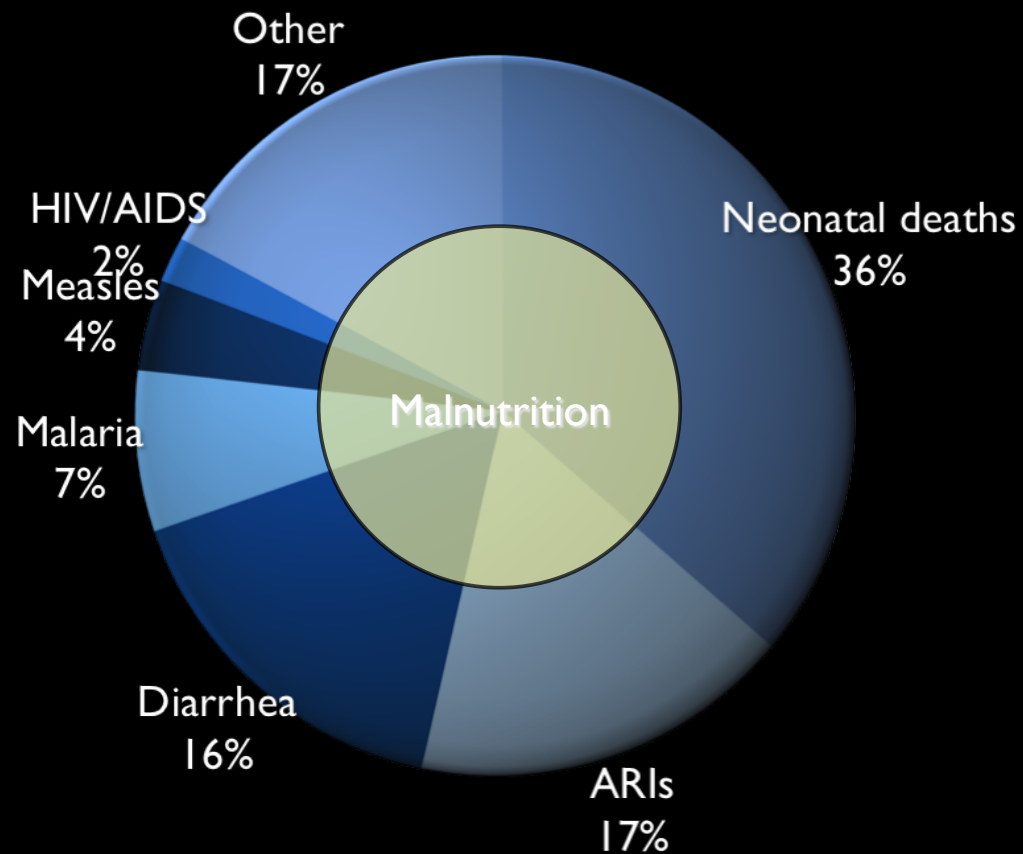
Causes of U5MR



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Scope of diarrheal illnesses

- In developing countries, children typically have 2-6 diarrheal illnesses each year
- ~2.2 million children under age 5 die each year (8,000 children/day)
- 1/20 children die before age 5

Other consequences of diarrheal illnesses

- Impaired...
 - ...nutrition
 - ...growth and development
 - ...cognitive and school performance
- Susceptibility to other acute infections

Prevention strategies

- Improved living conditions
- Clean water
- Improved sanitation
- Personal hygiene / handwashing
- Exclusive breastfeeding 4-6 months



Photos by Brett Nelson. No permission needed.

Diarrheal etiology

Bacteria, viruses, and protozoa

E. Coli
Shigella
Salmonella
Vibrio cholera
Campylobacter jejuni
Cryptosporidium

Rotavirus
Noroviruses
Adenoviruses

Giardia
Entamoeba histolytica

Differential diagnosis

[WHO table: Table 11. Differential diagnosis of the child presenting with diarrhoea (Page 111). WHO Pocket book of hospital care for children in resource-limited settings. Available at: Image retrieved from <http://whqlibdoc.who.int/publications/2005/9241546700.pdf>]

Assessing degree of dehydration

- Which signs are useful in children?

[Diagram of dehydrated child. Available at: <http://wikieducator.org/File:Signsdehydration.jpg>]

Assessing degree of dehydration

	Mild (3-5%)	Moderate (6-9%)	Severe ($\geq 10\%$)
Urine output	Normal	Decreased	None in 12 hours
Activity level	Irritable	Lethargic	Very lethargic or unconscious
Pulse	Normal	Rapid	Rapid and weak
Fontanel	Normal	Sunken	Very sunken
Eyes	Decreased tears	Sunken, no tears	Very sunken, no tears
Mouth	Slightly dry	Dry	Very dry
Skin turgor	Good	Fair	Poor

Diarrhea: management

- Early replacement of fluid losses
 - Oral rehydration solution (ORS)....
- Continue/increase feeding and breastfeeding
- Recognize signs of significant dehydration or other concerning symptoms
- Antibiotic use only when appropriate
- Zinc x10-14 days

Cholera treatment

- Usually ORS adequate
- IVF in severe cases
- Abx: tetracycline, cotrimox., chloramphenicol, flouroq.
- Reduce transmission
- Treated mortality: <1% (vs. 50-60% untreated)

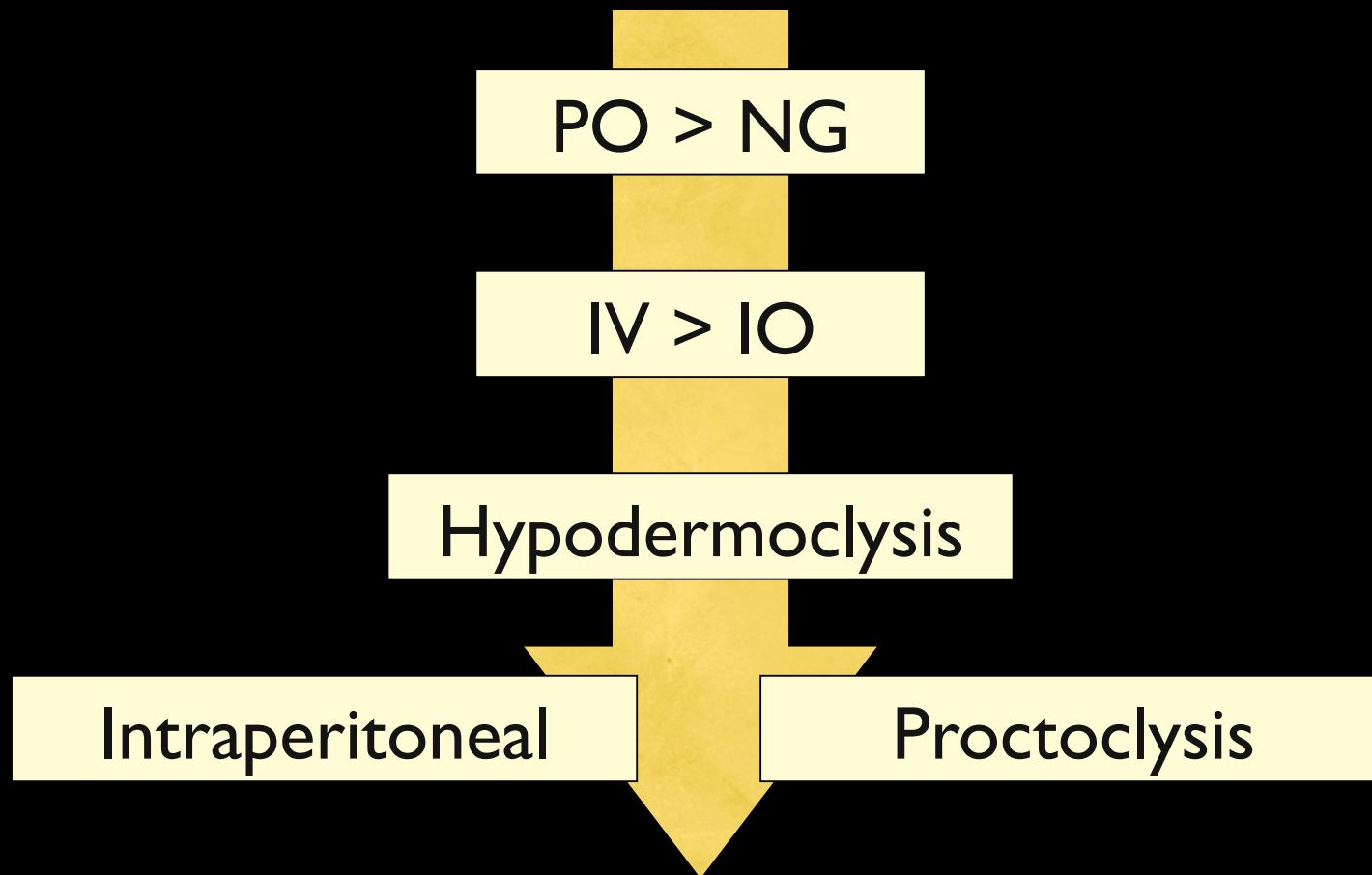


Image retrieved from http://commons.wikimedia.org/wiki/File:Cholera_hospital_in_Dhaka.jpg. Image in public domain by Mark Knobil under a Creative Commons license.

Rehydration methods

- PO
- NG
- IV
- IO
- Hypodermoclysis
- Intraperitoneal
- Proctoclysis

Rehydration algorithm



Special considerations: umbilical, central

Oral rehydration solution (ORS)

Sodium and glucose solution
for management of acute
diarrhea

*“Potentially the most important
medical advance of this century”*

Water with sugar and salt [editorial]. Lancet 1978;2(8084):300-1.

[Image of ORS sachet.
Available at: [http://
www.unicef.de/projekte/
themen/nothilfe/nothilfe-
medizinische-versorgung/](http://www.unicef.de/projekte/themen/nothilfe/nothilfe-medizinische-versorgung/)]

Development of ORS

- First researched in 1940s, fully developed 20 years later by cholera researchers in Bangladesh and India
- During 1971 war between India and Pakistan, shown that ORS could be given by non-medical personnel
 - Death rate 3% in refugee camps with ORS (vs. 20-30% in camps with only IVF)
- WHO adopted ORS in 1978 as primary tool for fighting diarrhea

Physiology of ORS

- H₂O absorbed by creating osmotic gradient:
- Na⁺ transport coupled to glucose transport on luminal surface in small intestine
- Na⁺ gradient established by actively pumping Na out of cell via Na/K ATPase on basilar surface of cell
- H₂O subsequently follows Na across intestinal lining

[Non-public figure of water and solute transport across intestinal wall. From Duggan et al. *JAMA*. 2004;291(21): 2628-2631]

Strengths of ORS

- Simple preparation from readily available ingredients
 - Locally produced in 60 developing countries
 - 500 million sachets produced per year
- Inexpensive: <\$0.10/sachet
- Effective:
 - Successfully treat 90-95% acute diarrheal cases
 - Since introduction, annual child deaths from acute diarrhea fallen from 5 to 2 million
 - IVFs now only necessary in most severe cases

Standard versus reduced-osmolarity ORS solutions

	Standard ORS (mEq/L)	Reduced- osmolarity ORS (mEq/L)
Glucose	111	75
Sodium	90	75
Chloride	80	65
Potassium	20	20
Citrate	10	10
Osmolarity	311	245

Advantages of reduced-osmolarity ORS

- Reduced osmolarity decreases symptoms
 - Stool output reduced by ~20
 - Vomiting decreased by ~30%
 - Shorter duration of diarrheal symptoms in some studies
- Decreases need for IVFs by 33%
- However, some increased incidence of transient, asymptomatic hyponatremia

Home recipes for ORS

- If ORS sachets not readily available, alternative solution can be made at home:
 - 1 liter of clean water (or tea, soups, rice water, fruit juices)
 - 6 level teaspoons of sugar
 - $\frac{1}{2}$ level teaspoon of salt

[Image of home ORS recipe. Available at: <http://rehydrate.org/solutions/homemade.htm>]

(Image adaption: for reduced-osmolarity ORS, use 6 teaspoons of sugar and $\frac{1}{2}$ teaspoon of salt)

Home recipe for ORS

[Non-public figure of ORS home recipe:
palm of sugar +
pinch of salt +
cup of water]

ORS teaching points for parents

Wash yours and child's hands with soap and water before preparing and before feeding solution

Mix solution in clean pot

Give as much solution as child will take

e.g. 50-100 ml (<2yo) or 100-200 ml (>2yo) after each loose stool and between them

Continue to provide child with other fluids (e.g. breast milk and juices)

If your child vomits, wait ten minutes and give ORS again

If child still needs ORS after 24 hours, make a fresh solution

ORS does not stop diarrhea

ORS prevents dehydration; diarrhea will stop by itself

If diarrhea increases and/or vomiting persists, take child to a health clinic

Provide zinc daily x10-14 days

Obstacles to ORS implementation

While ORS saves ~1 million children annually, still ~2 million preventable diarrheal deaths annually

- ORS “requires” clean water
- Doesn't greatly reduce diarrhea
- Suboptimal acceptance by parents and health care workers
 - Possibly because too simple?
 - Over-reliance on anti-diarrheal medications, antibiotics, and IVFs
- Insignificant profit margin in ORS
- Errors can occur in mixing ORS

Hypodermoclysis

- Infusing fluid into subcutaneous tissue
- Useful option when unable to hydrate orally and difficult to insert IV
- Sites include abdomen, upper chest, scapular area, thighs, and outer aspect of upper arm
- May use continuous infusion or bolus



Photo by Brett Nelson. No permission needed.

Summary

- Diarrheal illness is third leading cause of U5MR
- Simple approaches exist to prevent these deaths
- Use antibiotics for appropriate indications
- Remember ORS, zinc, and alternative rehydration methods

Practicum #1

- Make your own ORS! Mmmmm....

[Non-public figure of ORS home recipe:
palm of sugar +
pinch of salt +
cup of water]

Practicum #2: MUAC

- Acute malnutrition if one of the following:
 - MUAC < 115mm (screening)
 - Weight-for-height <70% or <-3 SD
 - Bilateral pedal edema
 - Clinical signs of severe malnutrition

MUAC

(Mid Upper Arm Circumference)

- Some data suggest best predictor of mortality in children 1-5 years
- Community volunteers easily trained
- Recommended for screening
- Children who meet criteria for malnutrition are referred

[Image of child being assessed with MUAC. Available at:
http://www.unocha.org/cerf/ar/2011/sites/www.unocha.org.cerf.ar.2011/files/images/Nig_Giacomo-Pirozzi.jpg]

Practicum:

- Measuring MUAC

[Image and directions for using a MUAC tape. Available at: http://www.fantaproject.org/downloads/pdfs/anthro_2003.pdf]

(Image adaption: the WHO now recommends the cut-off for referral be <115mm instead of <110mm)