

# INTRODUCTION

- WHO: “Malnutrition is the gravest single threat to the world’s health.” Improving nutrition is widely regarded as the most effective form of aid... and also is cheaper than other forms of aid.

- In 2006, hunger and micronutrient deficiencies accounted for 36mil out of the total 62mil deaths worldwide. About 60% of the children who die before age 5 die from malnutrition-related causes.

Malnutrition also has long-term outcomes: Worse health, lower educational achievements, smaller children, more disease.

- There is enough food in the world -- the problem is in its distribution.

# DETERMINANTS OF NUTRITIONAL STATUS

## BASIC DETERMINANTS

- Potential Resources: Human, agro-ecological, technological

- Climate change, Drought, Natural disasters, Conflicts/wars, Disease/pandemics

- Economic Structure

- Political & Ideological Framework

- Institutions

## UNDERLYING DETERMINANTS

- Household Food Security: Quantity & quality of food, Access to food, Cash/food prices

Quality of Caregiver: Knowledge & access to education, Health status, Control of resources

- “**Breast feeding** in the first 2 years & exclusive BF in the first 6 months could save 1.3mil children’s lives each year.”

- IUGR & low birth weight accounts for another 2mil infant deaths/year

- Healthy Environment, Health Services: Availability of public health resources, Sanitation, Clean water

## INTERMEDIATE DETERMINANTS

- Dietary Intake

- Health Status

## OUTCOME

### Nutritional Status

## LONG-TERM MEASURES

Local production of nutritional foods (such as ready-to-use foods [RUF])

Breast feeding education

Improving local agriculture (fertilizers, irrigation, education, etc.)

“Food sovereignty” vs. free trade...

Micro-lending...

## W.H.O. GUIDELINES:

## TREATMENT FACILITIES

- Residential care (i.e. hospital) -- Essential at the outset, i.e. first 1-2 wks; until no medical complications, eating well, growing.

Non-residential care (i.e. nutritional rehab center) -- Rehab period; child comes in daily

## EVALUATION

### ASSESSING DEGREE OF MALNUTRITION (CRITERIA FOR ADMISSION)

- Severe malnutrition (admission required) -- Symmetrical edema \*or\* SD of wt-for-ht  $> -3SD$  ( $< 70\%$ )

- More recent guidelines add Mid-Upper Arm Circumference (MUAC) of  $< 11.5\text{cm}$  for children 6mo to 5 yrs of age.

### H&P

- Hx: Include details of diet (remote & recent), BF hx, N/V/D, urinary sx's, risk factors for measles/TB/HIV, sibling health, BW, developmental milestones, immuniz'ns

- PE: Ht/Wt calculations, edema  $>$  vitals (incl temp!), AMS, thirst, pallor, skin infxn/purpura, corneal lesions (i.e. vit A defic'y), ENT signs of infxn, signs of PNA or heart failure, liver/jaundice, abd dist'n/"abd splash," pulses, temp of hands/feet

### LABORATORY (WHEN AVAILABLE)

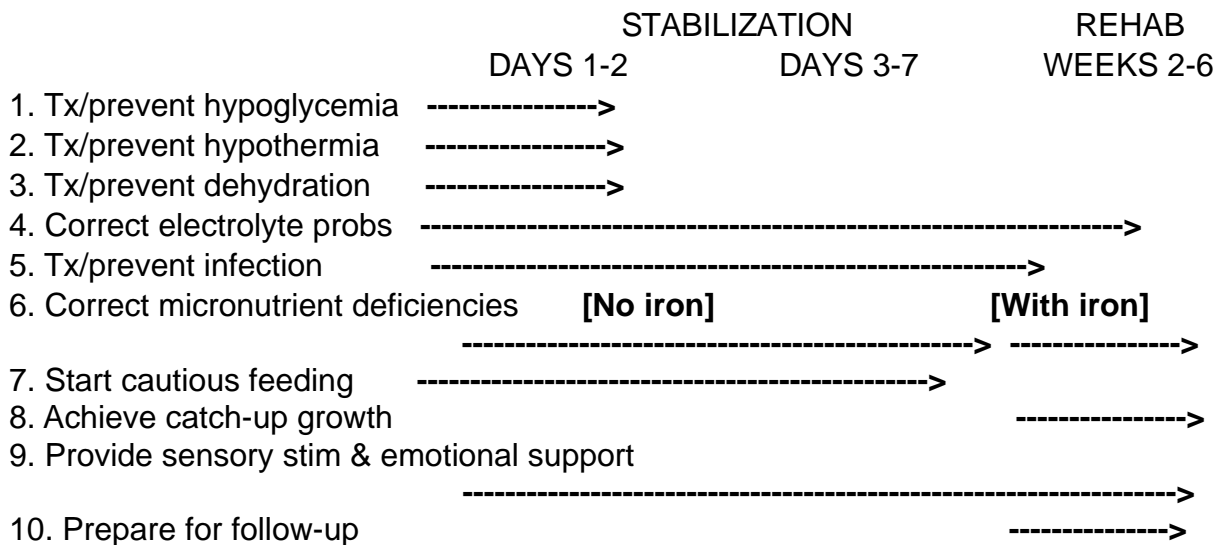
- Glucose, blood smear (malaria), Hb, UA (i.e. infxn), stool (for blood, signs of Giardia), CXR (to look for PNA/CHF/bone density probs), PPD, HIV

TESTS \*NOT\* TO DO: Serum proteins (useful for Px but not Tx), Electrolytes (electrolyte abnormalities are guaranteed and you treat them anyway)

# INITIAL TREATMENT

## 1. GENERAL PRINCIPLES:

<p>The 10 essential steps of care for severe acute malnutrition (SAM):</p>	
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## 2. HYPOGLYCEMIA

- i.e. BG <54mg/dl or <3mmol/l

- Major cause of death during the first 1-2 days

- Caused by infxn or no food x4-6hrs

- To prevent, feed at least Q2-3hrs ATC

- In malnourished kids, sweating/pallor/tremors often do \*not\* occur! Sometimes the only sign is drowsiness! Other signs: limpness, LOC

- If suspected, Tx immediately w/o lab confirmation!!! Can't harm; can only help.

- If can drink, give 50ml of 10% glucose/sucrose or F-75 diet (see below)

- If lethargic or convulsing, give 5ml/kg of 10% glucose IV, followed by 50ml of 10% glucose by NG tube (or NG dose first if no IV access)
- Once stable, con't frequent feedings with F-75 or glucose in water.
- Also Tx with broad-spectrum abx (see below)

### 3. HYPOTHERMIA

Highest risk: <12mo, marasmus, large areas of skin damage, serious infxns

If rectal temp <96F or axillary temp <95F -- Room temp of 77-86F, skin-to-skin, clothes/blankets/hat, incandescent lamp. NOT hot water bottles (dangerous)!

- Re-check rectal temp (axillary not accurate) q30min, to prevent overheating
- Eval/tx for hypoglycemia & infxn as well.

### 4. DEHYDRATION & SEPTIC SHOCK

- These two are hard to differentiate in a severely malnourished child, and often the clinical picture is mixed! Therefore, the child is often treated for both.

Diagnosis

NON-RELIABLE signs of dehydration: Depressed mental status (also occurs in hypoglycemia, hypothermia, & septic shock); Dry mucous membranes (common in all malnourished kids); Skin elasticity (falsely positive in malnourished kids... or falsely negative if edema present)

RELIABLE signs:

- Dehydration: Watery diarrhea, Thirst, Sunken eyes (only if mom says it's recent), Anorexic/non-thirsty
- Septic shock: Non-watery diarrhea, Hypothermia, Apathy/non-restless, Venous engorgement, Organ failure, Coffee-ground vomit, Shallow cough/SOB
- Both: Weak/absent pulses (lack of proximal pulses is a grave sign), Cold hands/feet (assess w/ back of hand), Low UOP

Tx of Dehydration

- Use oral solution whenever possible to prevent risk of over-hydration/heart failure. Use IV ~~only~~ if signs of shock.

- ORS (Oral Rehydr'n Salts): Severely malnourished children require LESS Na & MORE K than usual... Therefore, special solutions are needed...

- "ReSoMal" is a specially-designed ORS for severely malnourished children. It can also be specially made from the standard WHO ORS solutions (see document for directions).

- Rehydration also needs to be done more slowly for severely malnourished children. Reassess *at least* every hour! Look for how much the child can tolerate, signs of ongoing losses in the stool, signs of over-hydration, signs of heart failure. STOP if incr. RR/pulse/edema, JVD.

- Rehydration is complete if child is no longer thirsty, good UOP, & no more diarrhea.

- DO NOT interrupt BF or regular feeding!!

#### Tx of Septic Shock

- *Immediate* abx, re-warming, & BS control! Better to over-Tx than under-Tx.

- If in shock, immediate IVF & watch carefully (i.e. q5-10min!) for signs of over-hydr'n or cardiac failure. Switch to oral/NGT once present pulse & LOC

- If CHF, give blood transfusion if you have it.

- If signs of liver failure, give an IM dose of vit K

NEVER use steroids or epinephrine!

Don't handle or bathe the child! (only clean the bottom after stools/urine)

## 5. DIETARY TREATMENT

Once BS, temp, & shock are Tx'd, start feeding immediately.

#### Formula Diets

- "Almost all severely malnourished children have infxns, impaired liver & intestinal fxn, & problems related to imbalance of electrolytes when first admitted to the hospital."

- Therefore, cannot tolerate usual amounts of protein, fat, & Na.

- Special formula diets are designed to be low in these nutrients & high in carbs.

- Two standard formula diets: F-75 (initial phase, high-carb) & F-100 (rehab phase, high protein/fat). Both are easy to prepare (Tb 7 in 1999 WHO guidelines)... but CANNOT leave out the mineral/vitamin mixes!!

#### Feeding on Admission

- Q2-4hrs ATC. If vomiting, give less food more frequently.

- Goal: 80-100 kcal/kg/day (see table 9 in 1999 WHO guidelines).
- Child will likely need significant coaxing for the first several days.
- NEVER use a bottle (risk of infxn), and NEVER leave child alone to feed oneself.

#### Nasogastric Feeding

- May be necessary during first few days (painful stomatitis, weakness, poor appetite)
- Give food thru NGT only after eating first, and remove NGT a.s.a.p.

#### Feeding After the Appetite Improves

- Appetite begins to improve sometime on day 2-7. Is a sign that infxns are resolving, liver is working again, & other metabolic abnormalities are improving.
- Once child is hungry & eating, switch to F-100 (rehab phase) ~ much higher %'s of protein & fat.

Change should be made carefully to avoid overfeeding.

- See discussion on ready-to-use foods (RUF) below.

#### Milk Intolerance

- Historically, if child not doing well, the cause has occasionally been erroneously ascribed to “milk intolerance.”
- Should only be diagnosed if clearly obvious.
- Milk products should be re-tried before discharge.

#### Recording Food Intake

- Date, time, type of food, amount of food
- Outs should be recorded too (vomit, urine)
- Once daily calculation to assure child is taking 80-100kcal/kg/day. Increase or reduce accordingly.

## 6. INFECTIONS

#### Bacterial Infxns

- *Nearly all* severely malnourished children, and often hard to detect. May be only apathetic or drowsy.
- Therefore, *all* children should initially get broad-spectrum abx.

If no complic'ns & no signs of infxn, start w/ BID TMP-SMX

If (+) complic'ns (shock, hypoglycemia, hypothermia, signs of infxn, etc.), give amp+gent x2days, then amox+gent x5days

If no response (i.e. decr anorexia) in 48 hrs, add chloramphenicol

Studies unclear regarding the addition of metronidazole (as of 1999...)

- Watch out for dysentery, candidiasis, malaria, intestinal helminths, etc.

- Give TB drugs, *only* if TB is dx'd

Measles & Other Viral Infxns

- Measles vaccine *on admission*, 2nd dose on discharge

HIV/AIDS

- Follow pretty much the same protocol.

- ELISA can be falsely (+) during the first 15 months (maternal Ab's)

- "In children, CD4 count is best expressed as a percent of the total lymphocyte count."

- Dearth of research on the use of HIV meds in severely malnourished children (at least as of 2004...).

## 7. VITAMIN (& MINERAL) DEFICIENCIES

Vitamin A Deficiency

- High risk of blindness due to vit A deficiency.

- Si/sx: Night blindness, conjunctival/corneal xeroses/ulceration, Bitot's spots [keratin build-up on conjunctiva], keratomalacia [dry cornea].

- *Examine eyes carefully and gently!!! (very fragile in vit-A deficient children)*

- Therefore, large dose is given to all children on day one, unless clearly given in past month.

- If si/sx present, give 2nd dose on day 2 and 3rd dose in >2wks.

- If inflam'n/ulceration in the eyes, give tetracycline **QID** until resolved.

- Atropine eye drops should also be given, and the eyes should be bandaged...

Other Vitamin/Mineral Deficiencies

- Daily folic acid (5mg on day 1, 1mg thereafter)

- Vitamin mix in F-75 or F-100 includes riboflavin (B2), pyridoxine (B6), Thiamine (B1), Vit C, and the fat soluble vitamins (D/E/K).

- Re, Minerals:

- NO IRON during initial phase, as it can reduce resistance to infxn.
- Zn is critical for skin health (see “Dermatosis of Kwash...” below)

## 8. VERY SEVERE ANEMIA

- Makes high risk for CHF. Therefore, transfuse if Hb < 12 or signs of CHF.

## 9. CONGESTIVE HEART FAILURE

- Most common causes: Over-hydration (*beware of IVF* -- only give when absolutely necessary!!), Severe anemia, Blood/plasma transfusions, or too much Na.
- Initial sign is Tachypnea, then TachyC, JVD, Cold hands/feet, Periph cyanosis
- Must be diff'd from septic shock or resp infxn, both of which usually occur earlier (i.e. 1st 48hrs).
- If 2/2 fluid overload, stop ALL PO/IVF and give furosemide. Digoxin OK if JVD+nml K+.

## 10. MARASMUS, KWASHIORKOR (& OTHER SKIN CHANGES)

Marasmus: Severe *nutritional defic'y*. Mm/fat wasting, irritable, strong appetite, skin peeling, patchy changes in hair/skin color. Gen effects infants & small children. Tx consists of vitamins.

Kwashiorkor: Severe *protein defic'y*, leads to osmotic changes. Edema/abd distention, mm wasting, skin “burns” (see below), immunodeficiency leading to infxns/vomiting/diarrhea. Generally effects slightly older children. May be present where there is more food but not enough protein food. Tx is generally milk.

- Severe diaper dermatitis --> Leave uncovered & give oral+topical nystatin.
- Barrier/moisturizer creams such as Zn, petrolatum jelly, or paraffin gauze are also helpful.
- ALL children get systemic abx as well (as noted above).

## REHAB

Occurs *when child's appetite returns*.

### 1. PRINCIPLES OF MANAGEMENT

- Criteria for transfer to a rehab center: Eating well, Nml mental status, Appropriate activity level, Euthermic, No vomiting/diarrhea, No edema, Gaining wt x >3 days.

- Principle tasks of rehab phase: Enc child to eat as much as possible (incl BF), Stimulate emotional & physical development, Prepare mother/family to care for child at home.

### 2. NUTRITIONAL REHAB

### Feeding Children < 24 Months

- F-100 q4hrs ATC
- When you first transition over, increase by 10ml/feed until the child refuses to eat everything. Some food should be left after every feed. Should get at *least* 130kcal/kg/day.
- *Never* re-use left-overs. *Never* leave child to eat alone. Encouragement is impt!
- Record all I/O's & daily wts. If not gaining wt, they MAY still be diuresing.

### Feeding Children > 24 Months

- *Solid foods can be introduced along side F-100, but...*
- Favor fortified foods, add oil & mineral/vitamin mixes.
- Give F-100 *between* feeds to avoid problems with absorption.
- Goal: 3 solid feeds & 3 F-100 feeds daily. Omit one nighttime feed when doing well.

Water upon request.

- New alternative: "Ready-to-Use Foods" (RUF) (i.e. Plumpy'Nut) -- "Fortifying foods such as Plumpy'Nut & Spirulina have revolutionized emergency feeding in humanitarian emergencies b/c they can be eaten directly from the packet, don't require refrigeration or mixing with scarce clean water, and can be absorbed easily in extremely ill children."

- Bulk-produced formulas.
- Programs working on helping developing nations build the infrastructure to make these products themselves.

### Folic Acid & Iron

- *Never* give iron during the initial period, due to decr'd resistance to infxn.
- But PO iron & folic acid are critical during rehab phase, along w/ other vit's/minerals.

### Assessing Progress

- Weigh daily & plot on graph.
- Response to Tx = *at least* 5g/kg/day (normal is 10-15 g/kg/day)
- *D/c home when child is at -1SD (90% median) of nml wt, or by another measure, has accomplished 15% weight gain. This takes 2-4 wks in most cases.*

## 3. EMOTIONAL & PHYSICAL STIMULATION

- Developmental delay can be one of the most serious long-term effects of severe malnutrition. Therefore, emotional/physical rehab is also critical.
- Be careful to provide an environment that allows the use of all sensory organs & move about w/o restriction (i.e. no swaddling...)
- Encourage caregivers to feed, hold, comfort, & play w/ the child as much as possible. Talk, smile, & show affection as much as possible.
- Minimize the number of caregivers, to provide consistency for the child.
- Hold & comfort after any uncomfortable procedures (i.e. blood draws), and do these procedures out of the earshot of other children.

### The Environment

- Relaxed, cheerful, warming, colorful atmosphere.
- Rooms should be brightly colored, decorated. Mobiles over each bed.
- Variety of safe, washable, appropriate toys. *Easily reproducible toys can be made out of cardboard, plastic bottles, tin cans, etc.*
- Staff dressed in normal clothing (not uniforms).

### Play Activities

- Interxn w/ other children. *Social/developmental benefit probably outweighs the risk of cross-infxn!!*
- Someone responsible for curriculum of play activities that stimulate both motor & language skills.
- Play w/ each child individually >15-30 min/day, PLUS informal group play.
- See Appx 8 for sample curriculum.
- Praise don't criticize.

### Physical Activities

- If too weak to move, passive limb mvmts & warm water baths may help.
- Kids should walk, role, run, climb, etc.
- Outdoor playground if sufficient space.

## 4. TEACHING PARENTS HOW TO PREVENT MALNUTRITION

- Much to learn -- Don't wait until the last few days before discharge!
- Teaching on nutr'n, tx'ing & preventing infxn, parenting skills, etc.

- Caregiver (i.e. mother) should spend as much time at the rehab center as possible. This may mean she will need support for travel/meals.
- Treat Mom as a partner. Encourage, don't blame/scold/humiliate.

## 5. PREPARATION FOR DISCHARGE

- Do nsg or SW home visit before discharge to assess adequacy of home/community environment.

### Criteria

- Child: -1SD (90%) median weight; Eating well; Gaining wt; All vit/min defic'ies tx'd; All infxns tx'd; All immunizations started
- Mother/caregiver: Able/willing to care for child; Knows how to prepare appropriate foods; Knows how to play w/ child; Knows how to tx basic medical needs (diarrhea, fever, URI, etc.) and when to seek medical help.
- Health worker: Is able to ensure f/u of the child & support for the mother.
- More recent recommendations suggest using a wt gain of 15% rather than calculating SD's or MUAC's, since this can be applied to both methodologies. (2009 document)

### Appropriate Diets

- At least 5 meals/day while in tx/rehab, then at least TID

### Immunizations

- On track to meet all immuniz'ns required by that particular country

### Planning F/u

- Home visits (preferably) by both RN and SW.
- F/u in clinic in 1 wk.

## FOLLOW-UP

- Should include a strategy for finding children who aren't following up.
- Risk of relapse or loss to f/u is highest in the first weeks/months after discharge.
- If all goes well, f/u in clinic in 1wk, 2wks, 1mo, 3mo, 6mo, then biannually until 3 yrs old.
- At each f/u assess child's health, mental/physical development (encourage stimulation of these!), food availability/quality, immunizations, etc.1

## FAILURE TO RESPOND TO TX

## GENERAL PRINCIPLES

- Primary failure to respond
- Secondary failure to respond

## PROBLEMS WITH THE TREATMENT FACILITY

### Type of Facility

- Specialized nutrition facility is ideal

### Staff

- Well-trained, positive staff

### Inaccurate Weighing Machines

Probs w/ Preparing or Giving Food

## PROBLEMS WITH INDIVIDUAL CHILDREN

### Feeding

- Enough food? Sufficient vitamins/minerals? Regurgitating food (i.e. “ruminating”)?

### Infection

- Persistent diarrhea, Dysentery, Otitis media, PNA, UTI, Skin infxns, TB, Helminthiasis, Malaria, HIV/AIDS

- (All are discussed briefly in the primary document.)

### Serious Underlying Disease

- Congenital abnormalities, Inborn errors of metab, Malignancy, Immunological Dz's, etc.

## LEARNING FROM FAILURE

- Keeping accurate records helps to assess for patterns of failure.

# DISASTER SITUATIONS & REFUGEE CAMPS

## GENERAL CONSIDERATIONS

- Ideal is to have a “therapeutic feeding center.”

## ESTABLISHING A THERAPEUTIC FEEDING CENTER

### Location & Capacity

- In or near a hospital; 50-100 children; ATC staffing

### Water Supply & Sanitation

- 30L/child/day!

## Cooking Facilities & Supplies

### Staff

- 1 part-time doctor, 3 RN's, & 10 nursing aides (at least!)

## CRITERIA FOR ENROLLMENT & DISCHARGE

- As above. May d/c as early as  $-2SD$  (80% median wt), but this should be shown to be stable x1 wk

## PRINCIPLES OF MANAGEMENT

- No changes

## EVAL OF THE THERAPEUTIC FEEDING CENTER

- Calculate mean daily mortality rates every week.
- Monitor availability of food & micro-/macronutrients every month.
- Do wt/ht surveys q3mo.
- Calculate # of enrolled children divided by the total # of severely malnourished children in the area.
- Calculate the recovery and mortality rates.
- **GOALS:** >80% coverage, >50% recovery, <15% mortality.

## ADOLESCENTS & ADULTS

- E.g. extreme famine, the elderly, prisoners, etc.

## PRINCIPLES OF MANAGEMENT

- The same as for children... but can be more difficult due to cultural barriers, resistance to taking formulas, etc.

## CLASSIFICATION OF MALNUTRITION

### Adults

- **BMI** <18.5 = mild malnutrition; **BMI** <17 = moderate; **BMI** <16 = severe.

- Assess for edema, and think if the **DDx** (preeclampsia, nephrotic syndrome, heart failure, wet beriberi, etc.)

### Adolescents

- Use **BMI**... <5th %ile if edema, <3rd %ile if no edema.

## H&P

## INITIAL TX

- Same as children... but lower caloric requirements than for children (separate table).
- NG tube usually needed during first few days due to anorexia.
- Assess for hypoglycemia & hypothermia.
- Give abx (except in pregnant women) and vitamin A orally.

## REHAB

- Indicated by improving appetite.
- "Ready-to-Use Foods" (RUF) (i.e. Plumpy'Nut) -- See above.

## CRITERIA FOR DISCHARGE

- Eating well, Gaining wt, Access to nutrition outside the hospital, Other conditions tx'd

## FAILURE TO RESPOND TO TX

- Approach ~ same as for children.

## REFERENCES

- WHO Guidelines: "Management of Severe Malnutrition: A Manual for Physicians and Other Senior Health Workers." 1999. [HYPERLINK "http://whqlibdoc.who.int/hq/1999/a57361.pdf"](http://whqlibdoc.who.int/hq/1999/a57361.pdf)  
<http://whqlibdoc.who.int/hq/1999/a57361.pdf> (accessed April 2010).
- WHO-UNICEF: "WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants & Children" 2009. [HYPERLINK "http://whqlibdoc.who.int/publications/2009/9789241598163\\_eng.pdf"](http://whqlibdoc.who.int/publications/2009/9789241598163_eng.pdf)  
[http://whqlibdoc.who.int/publications/2009/9789241598163\\_eng.pdf](http://whqlibdoc.who.int/publications/2009/9789241598163_eng.pdf) (accessed April 2010).
- WHO Guidelines: "Guidelines for the Inpatient Treatment of Severely Malnourished Children." 2004. [HYPERLINK "http://www.who.int/nutrition/publications/severemalnutrition/guide\\_inpatient\\_text.pdf"](http://www.who.int/nutrition/publications/severemalnutrition/guide_inpatient_text.pdf)  
[http://www.who.int/nutrition/publications/severemalnutrition/guide\\_inpatient\\_text.pdf](http://www.who.int/nutrition/publications/severemalnutrition/guide_inpatient_text.pdf) (acc 4/10).
- WHO: "Severe Malnutrition: Report of a Consultation to Review Current Literature." 2004. [HYPERLINK "http://www.who.int/nutrition/publications/Lit\\_review\\_report.pdf"](http://www.who.int/nutrition/publications/Lit_review_report.pdf)  
[http://www.who.int/nutrition/publications/Lit\\_review\\_report.pdf](http://www.who.int/nutrition/publications/Lit_review_report.pdf) (acc 4/10)
- Wikipedia article on malnutrition (Accessed 4/2010).
- PIH Conference: "Integrating Health, Nutrition, and Food Security: Making the Case." [HYPERLINK "http://www.pih.org/inforesources/IHSJ\\_Food\\_Conference\\_2007\\_presentations.html"](http://www.pih.org/inforesources/IHSJ_Food_Conference_2007_presentations.html)  
[http://www.pih.org/inforesources/IHSJ\\_Food\\_Conference\\_2007\\_presentations.html](http://www.pih.org/inforesources/IHSJ_Food_Conference_2007_presentations.html) 2007 (Acc 4/2010).

Wikipedia article on malnutrition (Acc 4/2010).

“Where There Is No Doctor” has a nice summary for community health workers...