



Importance of Weight in the Treatment Outcomes of a Patient with TB

Catalina B. Navarro BSN, RN

September 24, 2026

TB Nurse Case Management • September 23 – 25, 2026 • Edinburg, Texas

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- No conflict of interests
- No relevant financial relationships with any commercial companies pertaining to this activity





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Nurse Consultant/Educator



Objectives

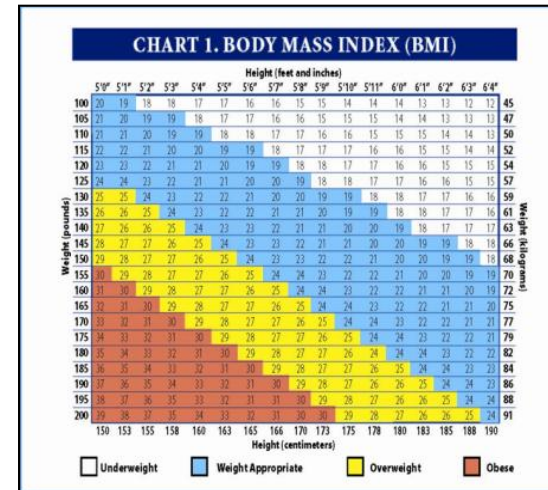
- Discuss the Importance of weight gain on TB treatment outcomes
- Demonstrate the use of the BMI chart with case studies


Impact of Poor Nutrition on TB Relapse
Reference: Lack of Weight Gain and Relapse Risk in a Large Tuberculosis Treatment Trial: Ayal Khan, Timothy R. Sterling, Randall Reves, Andrew Vernon, C. Robert Horsburgh and the Tuberculosis Trials Consortium; *American Journal of Respiratory and Critical Care Medicine* Vol 174, pp. 344-348, (2006)

Weight gain of 5% or less during the first 2 months of therapy is associated with an increased risk of relapse, even after controlling for other factors.

Consultation to healthcare providers at 1-800-TEX-LUNG
2303 SE Military Drive, San Antonio, TX 78223
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Malnutrition

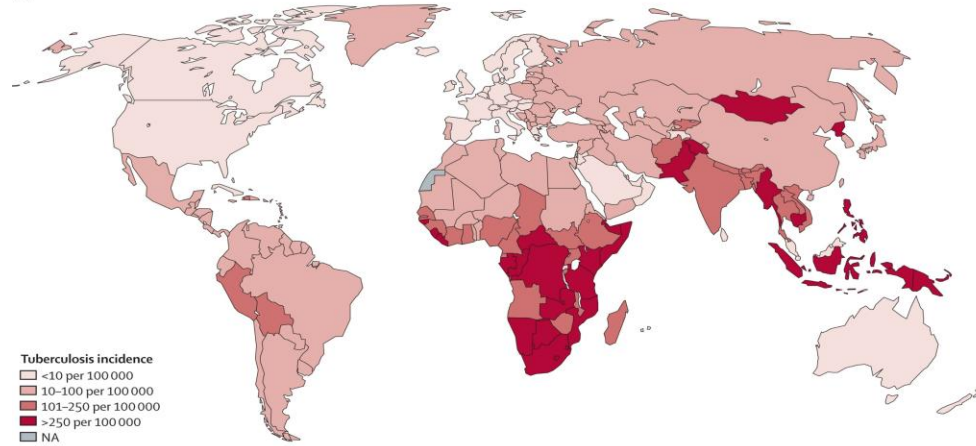
Malnutrition refers to **deficiencies**, **excesses**, or **imbalances** in a person's intake of energy and/or nutrients.

- **Undernutrition**
- Micronutrient-related malnutrition
- Overweight and obesity

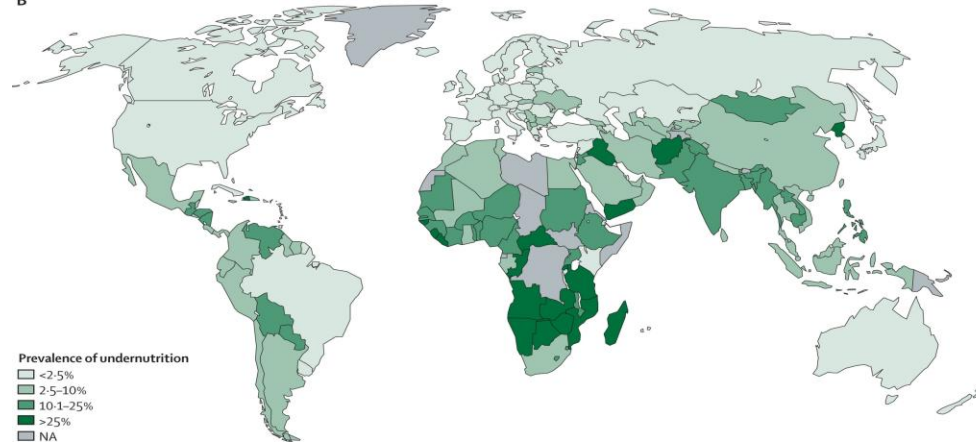


Geographic Overlap between TB and Undernutrition Worldwide 2018

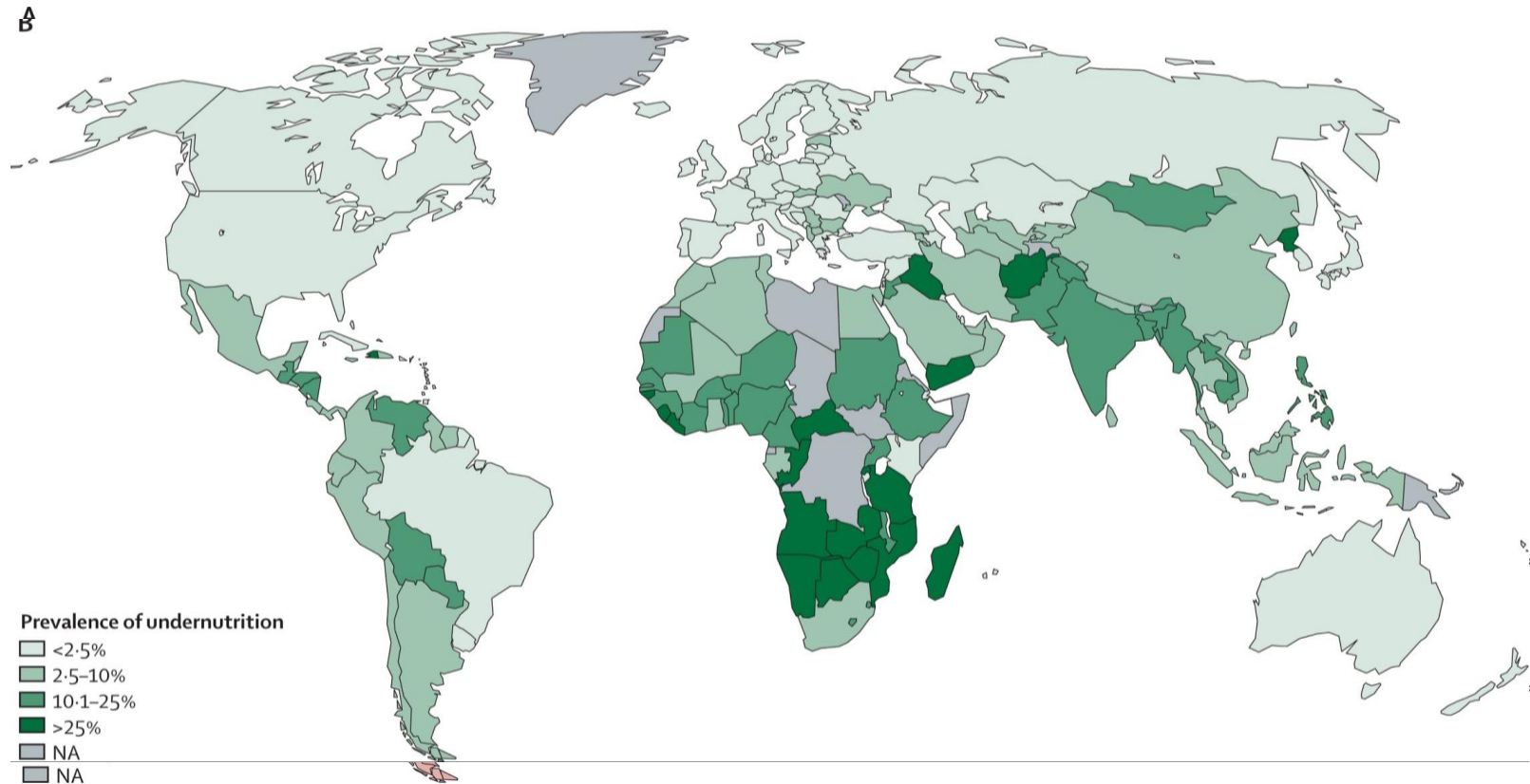
A



B



Geographic Overlap between TB and Undernutrition Worldwide 2018



Undernutrition and TB in India

People suffering from undernutrition are predisposed to contracting TB

Undernutrition contributes to a staggering **55%** of the annual TB incidence in India

For a TB-free India, break the cycle of hunger and disease

Malnutrition and tuberculosis are India's major public health challenges. And the importance of nutritional intervention as a weapon against tuberculosis cannot be overemphasised

ANALYSIS

Updated: Sep 08, 2017 17:48 IST

ht

Rajan Sankar



Impact of Diet on Tuberculosis Mortality: Historical Insights



“**Rise** in tuberculosis mortality was recorded in 1914-1916, and in those years the consumption of bread and flour rose, **whereas that of meat decreased.** .”--

“High TB mortality in Europe during and since WWII, coincided with **great reduction of intake of protein food**, such as, meat, fish and eggs”

[Sandler MD \(Diet Prevents Polio\)](#)



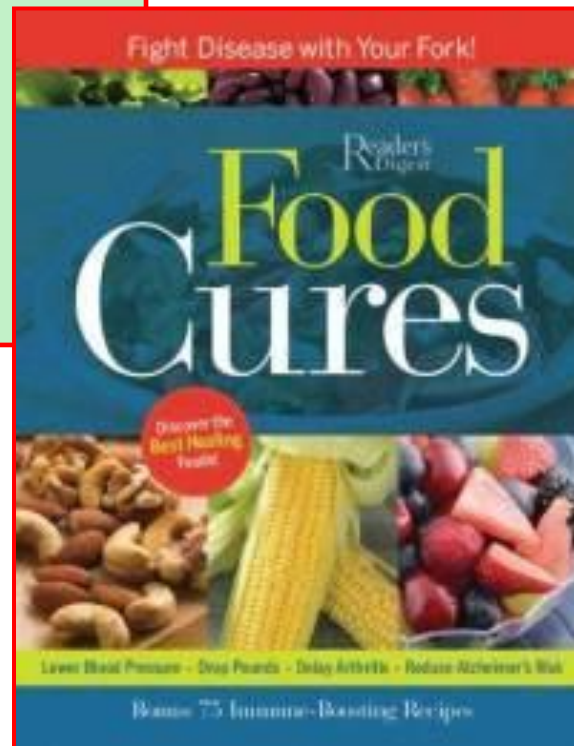
How Was TB Treated Prior to 1950?

Nutritious Food

Rest

Sunshine

Fresh Air



1906: BEFORE TB DRUGS

The “Consumptive Working Man”

THE CONSUMPTIVE WORKING MAN.

*What can Sanatoria do for
Him?*

NOEL DEAN BARDSWELL, M.D.

LONDON
THE SCIENTIFIC PRESS LIMITED
1906

*“Consumption” was the common term
for tuberculosis at the time.*

WHAT DID SANATORIUM CARE LOOK LIKE ?

Bardswell described treatment of working men in English sanatoria, with emphasis on rest, fresh air, and an adequate, high-calorie diet.

“Every patient should take an adequate diet as one of the essentials for the successful treatment of consumption.”

LONG-TERM FOLLOW-UP

≈45–50%

were reported in normal
health
and at full work

Follow-up ranged from about 1 to
5½ years after discharge.

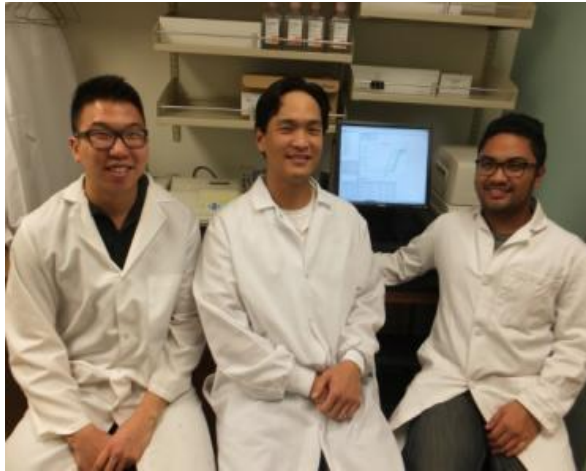
THE HISTORICAL LESSON

Nutrition was not an afterthought—it was considered essential supportive care.

Source: Noel Dean Bardswell, *The Consumptive Working Man* (1906); long-term outcomes reported in the book. Historical context—not evidence that diet alone cured TB.

Vitamin A and Tuberculosis

UCLA study shows vitamin A may play a key role in helping the immune system fight tuberculosis



UCLA Researchers

UCLA's Elliott Kim, Philip Liu and Avelino De Leon

February 25, 2014



MTB is Sensitive to Killing by a vitamin C-induced Fenton Reaction

VITAMIN C

Foods Sources

V	Valencia Orange	Cabbage, Red	Orange
I	Issai Kiwi Fruit	Cantaloupe	Papaya
T	Turnip Greens	Carambola	Pineapple
A	Apricots	Cauliflower	Potato
M	Mango	Cauliflower, Green	Prickly Pears
I	Ivy Gourd	Collard Greens	Pummelo
N	Nori	Chili Pepper, Hot	Radishes
C	Cantaloupe	Gooseberries	Raspberries
	Apricots	Grapefruit	Rutabagas
	Beans, Yellow Snap	Guavas	Spinach
	Bell Pepper	Kiwifruit	Squash, Summer
	Blackberries	Lemon	Strawberries
	Broccoli	Lime	Sweet Potato
	Brussels Sprouts	Nori	Tangerines
	Cabbage, Green	Mango	Tomato
	Cabbage, Pe-Tsai	Melon, Honeydew	Watermelon
		Okra	
		Onion	

Dietitians-Online©

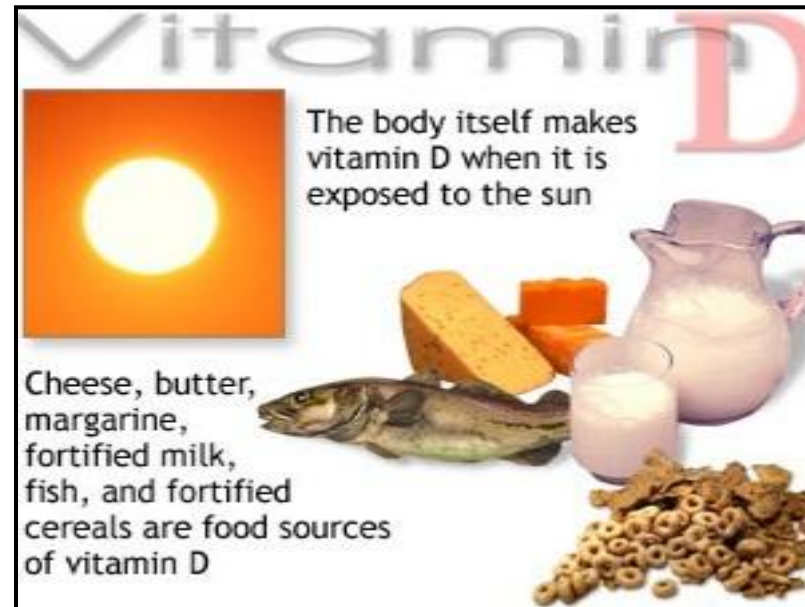
On April 4, 1932 Vitamin C was first isolated by CC King at the University of Pittsburgh.



<https://pmc.ncbi.nlm.nih.gov/articles/PMC3698613/pdf/nihms468905.pdf>

Vitamin **D** Powerful Weapon Against TB

Research shows that **adequate levels of vitamin D** can trigger the body's immune system to naturally respond to tuberculosis



Most Recent Systematic Review

Effects of Vitamin D Supplementation on the Outcomes of Patients With Pulmonary Tuberculosis

A Systematic Review and Meta-Analysis

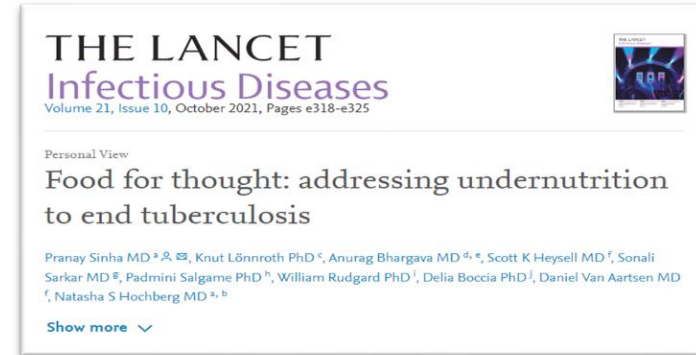
Hong-xia Wu; Xiao-feng Xiong; Min Zhu; Jia Wei; Kai-quan Zhuo; De-yun Cheng Disclosures BMC Pulm Med. 2018;18(108)

CONCLUSIONS:

Vitamin D supplementation can be considered as a combination therapy in patients with PTB.



Recent Studies 2021



Undernutrition is the leading population-level risk factor for tuberculosis.

Studies have consistently found that undernutrition is associated

- ✓ Increased tuberculosis incidence
- ✓ Increased severity
- ✓ Worse treatment outcomes
- ✓ Increased mortality

[Food for thought: addressing undernutrition to end tuberculosis - The Lancet Infectious Diseases](#)

WHO consolidated guidelines on tuberculosis

Module 6: Tuberculosis
and comorbidities

Second edition

Contents

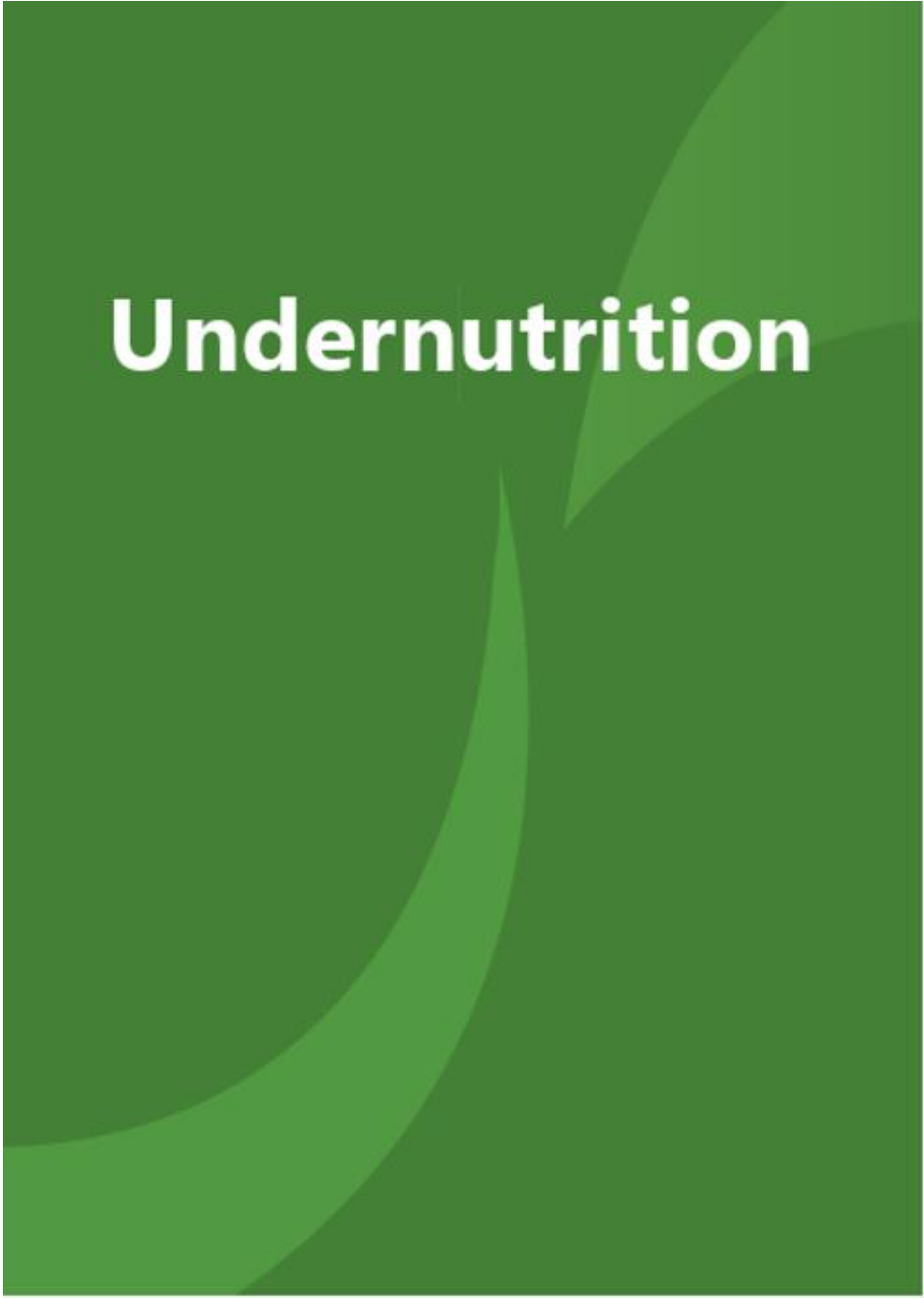
Introduction 1-3

HIV i-70

Undernutrition..... i-43

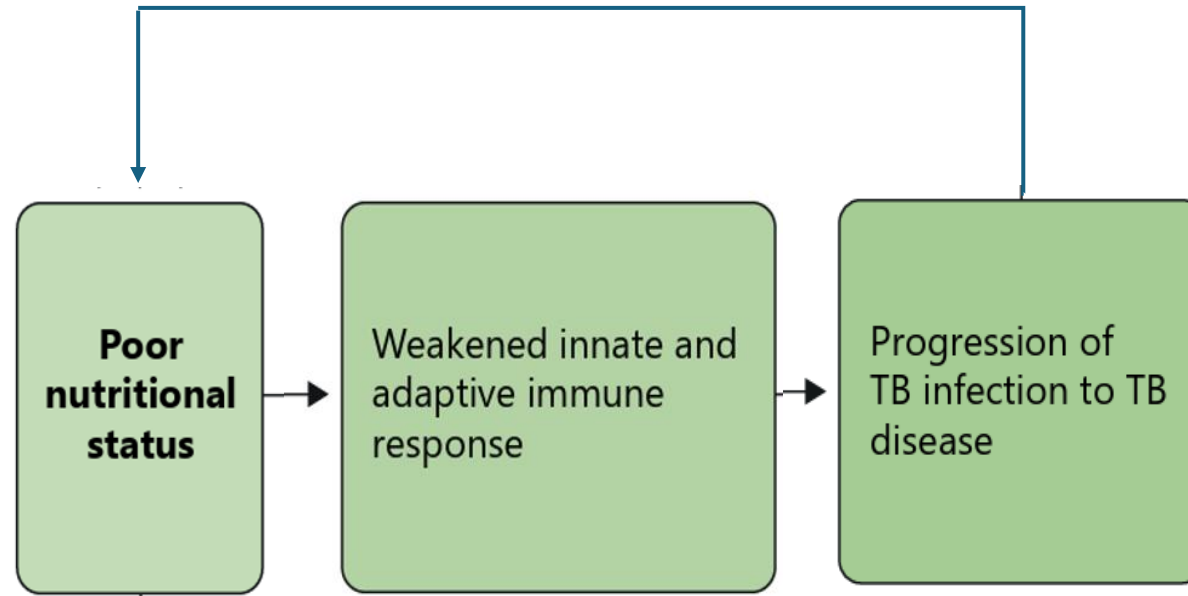
A solid red rectangular background with the word "HIV" in large, white, bold, sans-serif capital letters centered in the upper half.

HIV

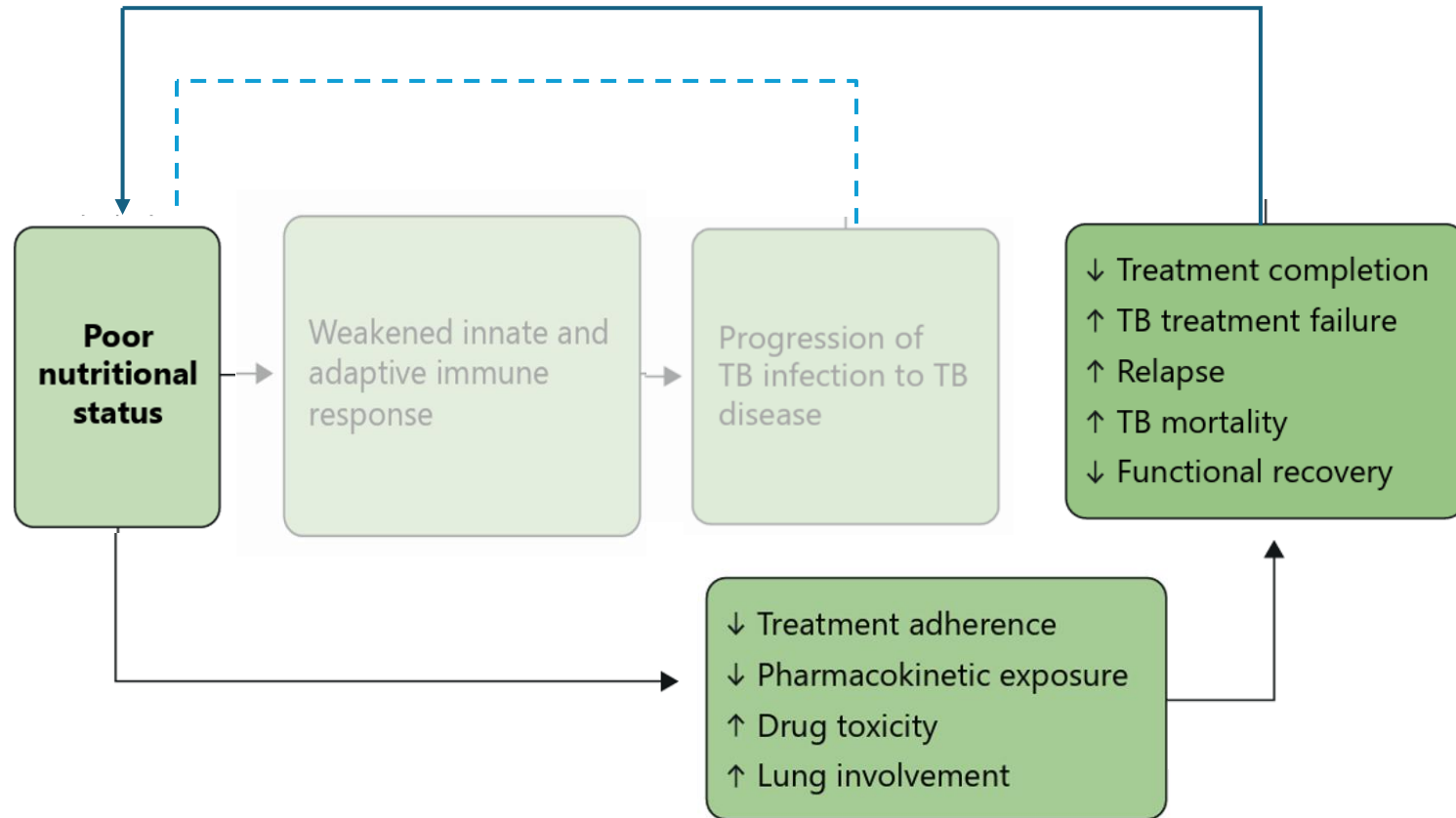
A solid green rectangular background with the word "Undernutrition" in white, bold, sans-serif capital letters centered in the upper half.

Undernutrition

Relationship Between Undernutrition and TB



Relationship Between Undernutrition and TB





This week

IJTLD LETTER © 2026

Impact of undernutrition and diabetes on the pharmacokinetics of first-line anti-TB drugs

Conclusion:

In summary, **underweight adults had substantially lower rifampin concentrations** and reduced target attainment under current dosing, and higher doses improved simulated attainment



RESEARCH ARTICLE

Effect of malnutrition on radiographic findings and mycobacterial burden in pulmonary tuberculosis

Kacie J. Hoyt^{1*}, Sonali Sarkar², Laura White³, Noyal Mariya Joseph⁴, Padmini Salgame⁵, Subitha Lakshminarayanan², Muthuraj Muthaiah⁶, Saka Vinod Kumar⁷, Jerrold J. Ellner⁸, Gautam Roy², C. Robert Horsburgh, Jr^{1,3,8}, Natasha S. Hochberg^{1,8*}

Conclusion:

Malnutrition was associated with **increased extent of disease and cavitation on CXR**

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0214011>

Why is Nutrition Important in a Person with TB?



Importance of Nutrition in TB Treatment Response

Lack of Weight Gain & Relapse Risk in a Large Tuberculosis Treatment Trial

*A. Khan, T. Sterling, R. Reeves, A. Vernon and the TB Trials consortium American
Journal of respiratory and Critical Care Medicine. Vol. 174*



Importance of Nutrition in TB Treatment Response



THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT TYLER
HEARTland
NATIONAL TB CENTER
A PARTNERSHIP OF UT HEALTH SCIENCE CENTER AND TCID

Impact of Poor Nutrition on TB Relapse

Reference: Lack of Weight Gain and Relapse Risk in a Large Tuberculosis Treatment Trial: Awal Khan, Timothy R. Sterling, Randall Reves, Andrew Vernon, C. Robert Horsburgh and the Tuberculosis Trials Consortium; *American Journal of Respiratory and Critical Care Medicine* Vol 174. pp. 344-348, (2006)

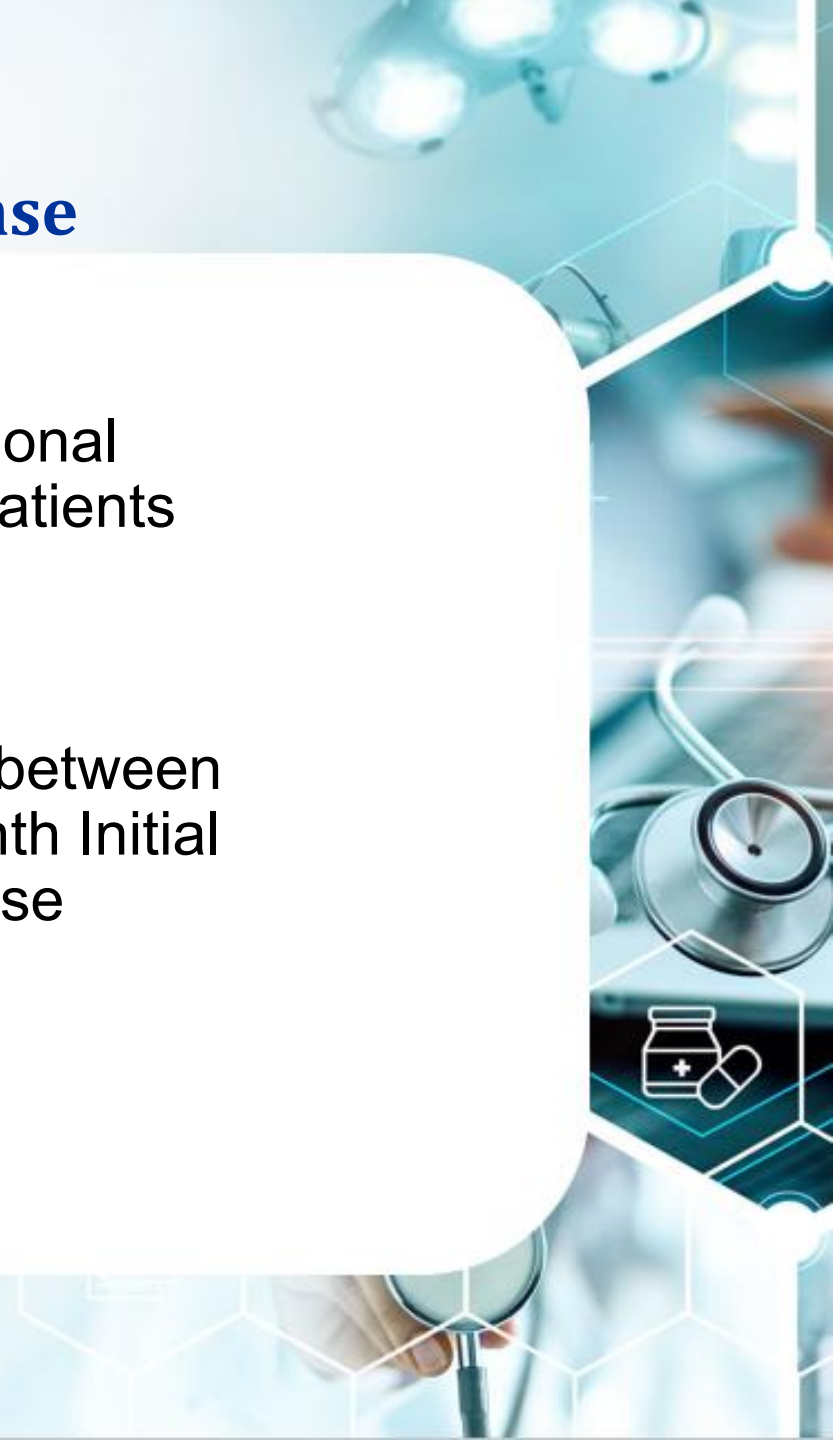
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Importance of Nutrition in TB Treatment Response

- ✓ The relationship between nutritional status and poor outcomes for patients with TB.
- ✓ The association of weight gain between diagnosis and the end of 2-month Initial Phase therapy and risk of relapse



Definition of TB Relapse



Patients remain **culture negative** during treatment ,
but after completion of therapy, they become
culture positive again or show clinical or
radiographic deterioration consistent with active TB



Lack of Weight Gain and Relapse Risk

- **857** subjects were enrolled.
- Monitored for two (2) years.
- **Body weight (kg) was measured at:**
 - ✓ Diagnosis
 - ✓ Enrollment in study
 - ✓ Monthly during treatment
 - ✓ And every 3-6 months during follow-up
- **Height**
- **BMI** (Body Mass Index)
- **IBW** (Ideal Body Weight)

Lack of Weight gain & Relapse Risk in a Large Tuberculosis Treatment Trial : A. Khan, T. Sterling, R. Reeves, A. Vernon and the TB Trials consortium . American Journal of respiratory and Critical Care Medicine. Vol. 174



WEIGHT AS A RISK FACTOR FOR TB RELAPSE

Underweight at Diagnosis ≥ 10% Below Ideal Body Weight			
	Weight gain after 2 months Rx	Relapse (%)	Cavitary AND Positive 2 months culture
Yes	≤ 5%	20.3%*	50.5%**
	> 5%	11.9%	18.5%
No		4.2%	18.3%

*p=0.06

**p=0.02

BMI	RELAPSE (5)
< 18.5	19.5%
18.51-19.0	10.7%
>19.0	6.1%

Body Mass Index (BMI) is optimal weight for health. Adults with a BMI between 19 and 24 have less risk for illnesses such as heart disease and diabetes than individuals with a BMI between 25 and 29. A BMI greater than 30 indicates greatest risk for obesity-related diseases. (See Chart 1.)

Adapted from The National Institute of Health, NHLBI Clinical Guidelines on Overweight and Obesity June 1998. www.nhlbi.nih.gov/guidelines.



Results

61 patients relapsed (7.1%)

<u>BMI</u>	<u>RELAPSE (5)</u>
< 18.5	19.5%
18.51-19.0	10.7%
>19.0	6.1%

Khan. 2006 Am J Resp & Crit Care Med;174:344-48



Lack of Weight Gain and Relapse Risk

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Yes	≤ 5%	20.3%*	50.5%**
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No		4.2%	18.3%



Remember....

Patients with **10% below ideal body weight** at diagnosis **that don't regain at least 5%** weight by end of two months of Rx



**At 2
months
sputum
culture (+)**

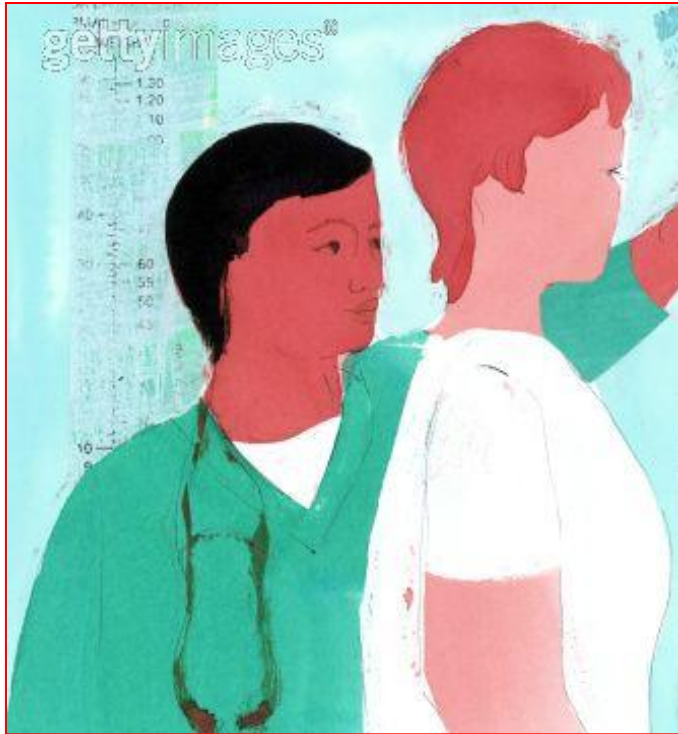


50% chance of relapse





Assessing Nutritional Status in a Person with TB



- **Weight/BMI:** Current and usual weight; recent weight loss (%).
- **Appetite/Intake:** Appetite and recent decrease in food intake.
- **Symptoms:** Nausea, vomiting, diarrhea, difficulty swallowing.
- **Clinical signs:** Muscle/fat loss, weakness, dehydration, edema.
- **Labs:** CBC, electrolytes, Albumin, Vit D, liver/kidney function as appropriate.



Laboratories (Normal Values)

Albumin:

3.8 – 5.2 g/dl

(Major protein. Low levels in poor diets, ↓ iron intake)

Total Protein:

6.0-8.5 g/dl (Low levels indicate poor nutrition)

Hemoglobin:

11.5 – 16 g/dl



13.2 – 17.1 g/dl

Hematocrit:

36.0 – 45.0 %



38.5 – 50.5 %



Glucose:

65 – 110 mg/dl

WBC:

3.8 – 10.8

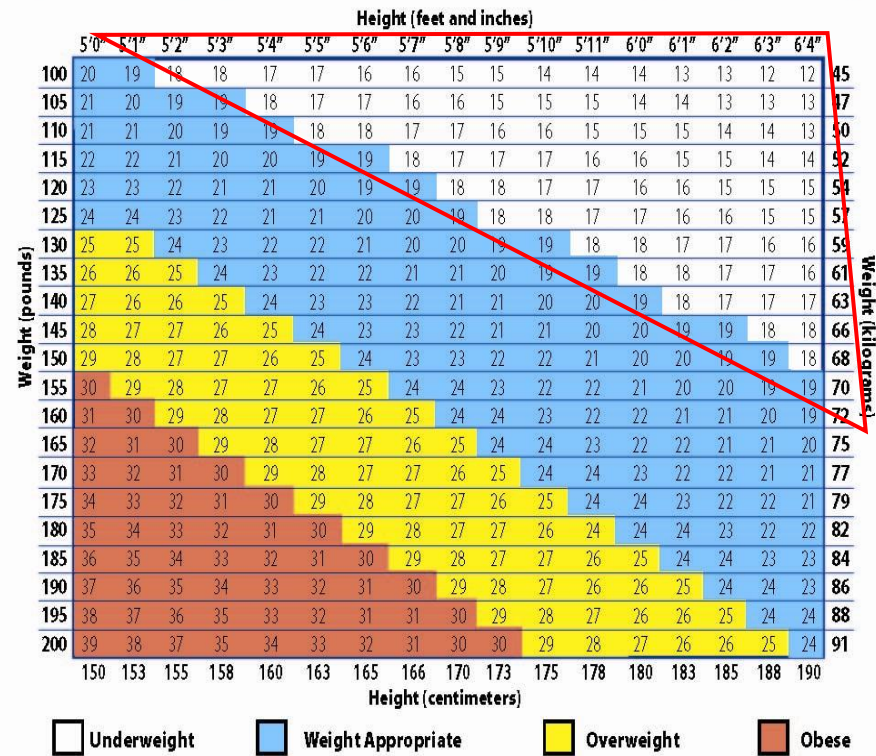
Lymph:

18-48 % (decreases with progressive malnutrition)



Body Mass Index (BMI)

CHART 1. BODY MASS INDEX (BMI)



Ideal Body Weight Table

METROPOLITAN LIFE TABLE FOR MEDIUM FRAME ADULT

Ideal Weight For Women

Height in Shoes	Medium Frame
6'	148 to 162 lb
5'11"	145 to 159 lb
5'10"	142 to 156 lb
5'9"	139 to 153 lb
5'8"	136 to 150 lb
5'7"	133 to 147 lb
5'6"	130 to 144 lb
5'5"	127 to 141 lb
5'4"	124 to 138 lb
5'3"	121 to 135 lb
5'2"	118 to 132 lb
5'1"	115 to 129 lb
5'	113 to 126 lb
4'11"	111 to 123 lb
4'10"	109 to 121 lb

Ideal Weight For Men

Height in Shoes	Medium Frame
6'4"	171 to 187 lb
6'3"	167 to 182 lb
6'2"	164 to 178 lb
6'1"	160 to 174 lb
6'	157 to 170 lb
5'11"	154 to 166 lb
5'10"	151 to 163 lb
5'9"	148 to 160 lb
5'8"	145 to 157 lb
5'7"	142 to 154 lb
5'6"	139 to 151 lb
5'5"	137 to 148 lb
5'4"	135 to 145 lb
5'3"	133 to 143 lb
5'2"	131 to 141 lb

From height and weight tables of the Metropolitan Life Insurance Company, 1983. The ideal weights given in these tables are for ages 25 to 59. The weights assume you are wearing shoes with 1-inch heels and indoor clothing weighing 3 pounds.



Nutritional Teaching TIPS!

- ✓ Considerer Prolonging therapy for patients $>10\%$ underweight.
- ✓ Calculate BMI and IBW %
- ✓ Monitor weight weekly in underweight patients.
- ✓ Once stable, monitor monthly
- ✓ Ideally patients should gain 1lb/week
- ✓ Provide food resources
- ✓ Recommend iron-rich food intake if client is anemic
- ✓ Recommend intake of food sources of vit A, C, Vit D (fish, butter, milk etc)
- ✓ Encourage the patient to monitor his/her weight.



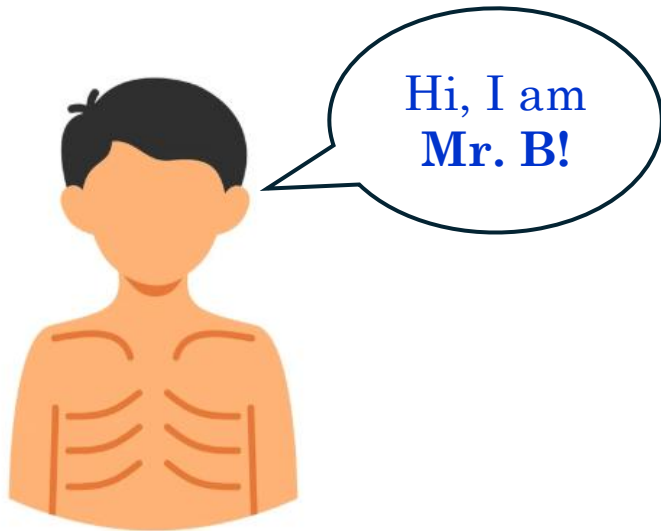
Weight Classification Based on IBW Percentage

Weight Classification	Percentage of IBW
Minimal Survival	48 – 55%
Severely Underweight	< 75%
Underweight	75 – 84%
Normal Weight	85 – 119%
Overweight	120 – 129%
Obese	130 – 140%
Morbidly Obese	> 140 %



How to calculate the % IBW?

$$\% \text{ IBW} = \frac{\text{Current Body Weight}}{\text{Ideal Body Weight}} \times 100$$



Mr. B

Height: 5'4"

Weight: 109lb IBW: (see chart) 140lb

$$\% \text{ IBW} = \frac{109\text{lb}}{140 \text{ lb.}} \times 100$$

= 77.8%

= (100% - 77.8%) = 22.2%



Below of the IBW

=





More Studies!

Int J Tuberc. Lung Dis. 2014 May;18(5):564-70. doi: 10.5588/ijtld.13.0602.

Body mass index predictive of sputum culture conversion among MDR-TB patients in Indonesia.

Compared to patients with **normal weight** ($BMI \geq 18.5$), **severely underweight patients** ($BMI < 16$) had longer time to initial conversion and a lower probability of sputum culture conversion within 4 months.

Conclusion:

Severe underweight was associated with **longer time to initial sputum culture conversion** among MDR-TB patients.



Case Study # 1



Case Study # 1



42-year-old Hispanic male admitted to *Texas Center for Infectious Disease* (TCID)

- Chronic diarrhea, severe undernutrition, difficulty walking, generalized weakness
- **60Lb weight loss**
- Disseminated TB involving lungs and bowel



Nutritional Assessment

Case study # 1

MC, 42 y/o Hispanic male
Admitted to the TB hospital

Diagnosis: Disseminated TB (lungs and bowel),
DM, Chronic diarrhea,
severe malnutrition

Age:	Sex:	Ht:	Wt:	Usual Body Weight:
42	M	5'7"	77.8	142 Lb
Frame Size:	Ideal Body Weight:	% IBW:	BMI:	Classification
Medium	142 Lb	54.7	12.2	Severely underweight

Labs:

ALB: 2.0
Hgb: 9.7
Hct: 26.3
GLUC: 161
WBC: 4.2
Hgb A1C 13.4%

Risk Factors:

- >20% underweight
- Disseminated TB
- GI TB
- Poorly control diabetes
- Smoker
- Lack of family support



Nutritional Assessment

Follow Up Case # 1

Diet advance slowly, pt. refuses to eat meals on regular basis, several episodes of hypoglycemia. Severe metabolic acidosis. Discharged after 1 year of treatment

Age:	Sex:	Ht:	Wt:	Usual Body Weight:
42	M	5'7"	114 Lb	142 Lb
Frame Size:	Ideal Body Weight:	% IBW:	BMI:	Classification
Medium	142 Lb	80 %	18	underweight

Labs:	Adm.	d/c
ALB:	2.0	3.2
Hgb:	9.7	12.1
Hct:	26.3	35.2
GLUC:		161
WBC:	4.2	4.8
Hgb. A1C	13.4%	

- Chronic pancreatitis/pancreatitis insufficiency
- Chronic condition, not reversible medication lifelong

High risk of relapse



Case Study # 2



Case Study # 2

Ms. RM: 82-year-old Hispanic female

- Admitted to hospital with **septic shock** and **multifocal pneumonia**
- Generalized weakness; non-ambulatory for the past 2-3 months
- Transferred to **ICU** for intensive care



Case Study # 2

- Declining health with severe malnutrition and cachexia
- Significant dental issues (poor dentition)
- 20 Lb weight loss
- Incontinence of urine and stool for the past 2 weeks
- Pulmonary tuberculosis with cavitary lesions on chest X-ray
- Poor prognosis



Case study # 2

RM 82 y/o female
TB
Admitted to TCID

Diagnosis: Pulmonary cavitary
Malnutrition

Age: 82	Sex: F	Ht: 4'8"	Wt: 65.7 Lb	Usual Body Weight:
Frame Size: Small	Ideal Body Weight: 97lb	% IBW: 67.7lb	BMI: 14.1	Classification Underweight/ Severely underweight

Labs:

ALB: 1.1
Hgb: 7.7
Hto: 24.2
GLUC:
WBC: 5.4

Risk Factors:

underweight ->20%
disease -Infectious
- Poor dentition



Nutritional Assessment

Follow Up Case # 2

Marked improvement during TB treatment. Soft diet with ensure. Good response to treatment and eating better after dental work

Age: 45	Sex: M	Ht: 4'8"	Wt: 98lb ↑	Usual Body Weight:
Frame Size: Small	Ideal Body Weight: 97 Lb	% IBW: 100%	BMI: 22	Classification Appropriate weight

Labs:

ALB:	3.2
HGB:	12.9
HTO:	39.4
GLUC:	97
WBC:	3.8



Case Study # 2

Pictures Updated



November 2017



April 2018





"Giving people medicine for TB and not giving them food is like washing your hands and drying them in the dirt"

Quote by a Haitian public health worker
Book: Mountains Beyond Mountains

THANK YOU!

