



## Syllabus

<b>Program Date:</b>	Online (ongoing)
<b>Program Times:</b>	N/A
<b>Instructional Methods:</b>	Text, Images, Audio Lecture, Video Lecture, Digital Interactivities, Assessments
<b>Course Title:</b>	Foundations of Functional Medicine
<b>Instructors:</b>	Laurie Mueller, DC, CFMP/ and Henry Mueller, DC, FACO, IFMCP
<b>Total CE Available:</b>	20 hours
<b>Topics/Category:</b>	General/Clinical Assessment

### Program Description and Objectives:

The term 'Functional Medicine' has become a moniker describing the global movement of how growing numbers of mainstream practitioners are changing the way they approach patient assessment and management based on systems biology and body system imbalances. "Foundations of Functional Medicine" was designed as an introductory course of study for allied health professionals that provides a strong overview of functional medicine concepts and includes the following objectives upon completion:

- Understanding of the foundational concepts of functional medicine and the premise behind a systems biology approach to assessment
- Ability to identify the 7 core imbalances
- Comprehension of the underlying physiology/mechanisms for each imbalance with correlations to disease processes and nutritional considerations
- Recognition of the special tools used by functional medicine practitioners to assess the patient with the functional approach
- Retention of knowledge to professionally interface with patients and other practitioners on this topic
- Acknowledge how the functional approach dovetails with other types of health management in an interdisciplinary environment
- Appreciate where to go to find further education or resources

### Course Breakdown:

#### Introduction (2 hours)

- Understand the definition of functional medicine and how it is fundamentally different from our current acute care models in the health arena. The important role of acute care for specific patient issues.

- Recognize the global burden of the chronic disease epidemic and our challenges with effective health care models.
- Understand the importance of finding a congruent approach to care in an interdisciplinary setting
- Define the 7 major system imbalances in functional medicine (introduction and definitions for each).
  - Digestion/Assimilation
  - Structural Integrity
  - Detoxification/Biotransformation
  - Energy/Metabolism
  - Hormones/Messengers (Communication)
  - Immunity/Defense
  - Cardiovascular/Lymph (Transport)
- Understand the functional approach through a case example
- Recognize prominent tools in functional medicine assessment: The Patient Timeline/ATM's (Antecedents, Triggers, Mediators)/Lifestyle Factors/The Patient Matrix Worksheet/Contributing Factors to Disease/the role of exam and labs
- Review the concept of Food/Nutrition as powerful sources of healing
- Definitions of Epigenetics/Nutrigenomics/SNPs

### **Assimilation/Digestion (5 hours)**

- Foundations of the assimilation imbalance, the historical context of disease processes manifesting from the GI system
- Understand the gut as the enteric nervous system and the significance of the interaction between the CNS and ENS
- Review gut function and how modern lifestyles affect the system
- Understand key gastrointestinal anatomy and physiology through the GI tract and accessory organs such as the liver, gallbladder and pancreas
- Proficient knowledge in the anatomy of the gut lining and the levels of damage that lead to leaky gut
- Appreciate the GI connections with immunological functions and neurotransmitter activity including the processes of SIBO and immune cross reactivity
- Recognize trends with systemic autoimmune activity and its correlations with gut function
- Comprehend the major foods that cause inflammation/damage and why
- Familiarize with important lifestyle factors that can affect assimilation
- Cognize that assimilation includes functions of the GI, lungs and skin and review imbalances within the GI system
- Review the mechanism of proton pump inhibitors and how they affect total digestion and systemic function along with a discussion of natural alternatives to PPIs
- Review the varied testing measures for stomach pH and other imbalance areas along the GI tract
- Comprehend an individualized approach to patient care along with varying strategies that may be implemented to balance out the function of assimilation/digestion including discussion about diet, nutritional supplements, lifestyle factors
- Learn the 5R approach to GI balance

### **Structural Integrity (3 hours)**

- Foundations of the structural integrity imbalance

- Review of macro level system/structures (tissue activity such as NMS)
- Review of micro level system/structures (cellular level activity such cell transport)
- Identify support factors for Bone, Muscle, and Nerve tissue
- Recognize subclinical signs of potential deficiency
- Features of the macro assessment
- The role of macro imbalances in wound healing and select disease processes
- Correlations between leaky gut autoimmune processes affecting structural tissues
- Explore imbalance at the micro level and building blocks of micro components
- Understand the dynamic nature of cell membranes
- Cognize the role the fats in cell membranes and how different types of fats can affect functionality
- The role of micro imbalances in select disease processes
- Recognize the significance of systemic inflammatory processes and oxidative stress
- Review top lifestyle factors affecting micro structures with a focus on nerve cells (mitochondrial cell activity will be covered in the energy unit)

### **Energy (2 hours)**

- Foundations of energy imbalance
- Understand the molecular units and activity required for ATP production and recycling
- Review mitochondrial activity within cells and tissues
- Recognize the stages of cell respiration and the role of digestion/assimilation within the process
- Appreciate specific substrates and cofactors within the processes of energy production
- Comprehend the current literature and correlations between disease processes and dysfunction in the mitochondria
- Review lifestyles and dietary element that can affect ATP production
- Understand organic acid testing in the urine that can help determine function
- Understand the amino acids needed in ATP production
- Review potential associated deficiencies
- Case example of toxic exposure effect on energy production
- Reactive oxygen species effect on cellular health
- Correlations with select disease processes
- Case example (2) of toxic exposure
- Mechanisms of certain Organochlorides/Rx/Pesticides/Heavy metals/Etc. on function
- Clinical strategies in assessment/labs for energy issues
- Case example (3) of fatigue
- Lifestyle/Dietary strategies

### **Biotransformation/Detoxification (2 hours)**

- Foundations of the detox/biotransformation imbalance
- Understand metabolite formation in bio transformative processes
- Recognize the prevalence of chemicals in the environment that can affect toxicity
- Comprehend the phases of detoxification and understand their significance
- Understand what requirements are needed for successful detox function
- Recognize liver function

- Realize the roles of the elimination process within detox function
- Recognize toxic load and common household toxins/heavy metals
- Review studies on correlations between toxic exposure and disease processes
- Case study
- Conventional lab tests as early indicators of exposure to select substances
- Recognizing detox enzymes with blood oxidative stress analysis
- Understanding glutathione measurements and superoxide dismutase
- Genetic correlations to detoxification function
- Organic acid testing and other testing considerations
- Detox strategies and considerations with lifestyle/diet
- System to address what is needed with detox and ensure a safe detox experience

### **Immunity/Defense/Repair (2 hours)**

- Foundations of the immune/defense imbalance
- Immune response and cell to cell signaling in innate and acquired immunity
- Components of human immune system components
- Barriers and inflammatory response
- Cytokines as small proteins and immune correlations
- Assimilation/Energy/Detox connections with immune challenges
- Concepts of immunosuppression and autoimmunity
- Allergy vs. Sensitivity vs Intolerance
- Immunoglobulin Levels and correlations IgA, IgG, IgM
- Reasons for immune system decline: age/inflammation
- Specifics about stress and immunity
- Concepts of immunosuppression and autoimmunity
- Lifestyle/diet strategies to build optimum immune health

### **Transport/Cardiovascular/Lymph (2 hours)**

- Foundations of transport imbalance
- Delivery Conduits/Transport of information and nutrients between tissues
- Ion concentration
- Vascular and lymph systems/Anatomy and function
- Disease process correlations: CVD
- Inflammation/Biomarkers/Relevance
- Strategies in lifestyle/diet

### **Communication/Messengers (2 hours)**

- Foundations of the communication/hormones/messengers imbalance
- Information/Instructions passed between tissues: Hormones, neurotransmitters, immune messengers/cytokines etc.
- Hormonal review/Anatomy/Physiology/Self-Regulation
- HPA, HPT and HPG axis and management considerations
- Steroidogenesis
- Stress and strategies for adrenal health

- Thyroid health
- Sex hormones
- Mood and other effects of imbalance
- Clinical considerations/Lifestyle and diet

## References:

Extensive references utilized for course creation includes but may not be limited to the following:

- [Clin Exp Immunol](#). 2008 Sep; 153(Suppl 1): 3–6. Allergy and the gastrointestinal system  
[G Vighi](#),\* [F Marcucci](#),<sup>†</sup> [L Sensi](#),<sup>‡</sup> [G Di Cara](#),<sup>†</sup> and [F Frati](#)<sup>†</sup>
- The Second Brain Michael D. Gershon, MD
- <http://darwinian-medicine.com/all-disease-begins-in-the-gut/>
- <http://www.nlm.nih.gov/medlineplus/ency/article/003883.htm>
- Johnston N, Knight J, Dettmar PW, Lively MO, Koufman J (Dec 2004). "Pepsin and carbonic anhydrase isoenzyme III as diagnostic markers for laryngopharyngeal reflux disease". *The Laryngoscope*. 114 (12): 2129–34.
- Goldberg HI, Dodds WJ, Gee S, Montgomery C, Zboralske FF (Feb 1969). "Role of acid and pepsin in acute experimental esophagitis". *Gastroenterology*. 56 (2): 223–30.
- Hamosh, M. (1984) in *Lipase* (Borgstrom, B. & Brockman, H. L., eds) pp. 49 - 81, Elsevier, Amsterdam
- *Adv Nutr*. 2013 Mar 1;4(2):226-35. doi: 10.3945/an.112.002998, Lustig RH. Fructose: it's "alcohol without the buzz".
- <https://www.gdx.net/core/one-page-test-descriptions/Pancreatic-Elastase-Test-Description.pdf>
- Scandinavian Journal of Gastroenterology, June 2014, Vol. 49, No. 6 : Pages 681-689 Surface area of the digestive tract – revisited ,Herbert F Helander , Lars Fändriks
- THE JOURNAL OF BIOLOGICAL CHEMISTRY Vol. 235, No. 11, November 1960 Properties of Intestinal Lipase, RENALD R. DINELLA,t H. C. MENG, AND C. R. PAR
- Groschwitz, Katherine R.; Hogan, Simon P. (2009-07-01). "[Intestinal Barrier Function: Molecular Regulation and Disease Pathogenesis](#)". *The Journal of allergy and clinical immunology*. 124 (1): 3–22. doi:[10.1016/j.jaci.2009.05.038](https://doi.org/10.1016/j.jaci.2009.05.038). ISSN 0091-6749. PMC 4266989. PMID 19560575.
- [Tissue Barriers](#). 2013 Dec 1;1(5):e27321. doi: 10.4161/tisb.27321. Epub 2013 Dec 10. The role of Haptoglobin and its related protein, Zonulin, in inflammatory bowel disease. [Vanuytsel T](#)<sup>1</sup>, [Vermeire S](#)<sup>1</sup>, [Cleyne J](#)<sup>1</sup>.
- [Curr Opin Pharmacol](#). 2009 Dec; 9(6): 715–720. Published online 2009 Jul 24. doi: [10.1016/j.coph.2009.06.022](https://doi.org/10.1016/j.coph.2009.06.022)
- PMID: PMC2788114 The Tight Junction in Inflammatory Disease: Communication Breakdown [Karen L. Edelblum](#)<sup>1</sup> and [Jerrold R. Turner](#)<sup>1</sup>
- The Journal of Nutrition Regulation of Tight Junction Permeability by Intestinal Bacteria and Dietary Components [Dulantha Ulluwishewa](#)<sup>3,5</sup>, [Rachel C. Anderson](#)<sup>3</sup>, [Warren C. McNabb](#)<sup>4,5</sup>, [Paul J. Moughan](#)<sup>5</sup>, [Jerry M. Wells](#)<sup>6</sup>, and [Nicole C. Roy](#)<sup>3,5,\*</sup>
- Immunology and the Gut [https://www.youtube.com/watch?v=gnZEge78\\_78](https://www.youtube.com/watch?v=gnZEge78_78)
- *Nat Rev Microbiol*. 2005;3:431-438 [World J Gastroenterol](#). 2010 Jun 28; 16(24): 2978–2990. Published online 2010 Jun 28. doi: [10.3748/wjg.v16.i24.2978](https://doi.org/10.3748/wjg.v16.i24.2978)PMCID: PMC2890937Small intestinal bacterial overgrowth syndrome [Jan Bures](#), [Jiri Cvrany](#), [Darina Kohoutova](#), [Miroslav Förstl](#), [Stanislav Rejchrt](#), [Jaroslav Kvetina](#), [Viktor Vorisek](#), and [Marcela Kopacova](#) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2890937/>
- *Nat Clin Pract Gast Hep*. 2005;2:416-422: Fasano, Donohue Mechanisms of disease: the role of intestinal barrier function in the pathogenesis of gastrointestinal autoimmune diseases.
- *Clin Gastroenterol Hepatol*. 2012 October ; 10(10): 1096–1100. doi:[10.1016/j.cgh.2012.08.012](https://doi.org/10.1016/j.cgh.2012.08.012)Fasano, A. & Shea-Donohue, T. Mechanisms of disease: the role of intestinal barrier function in the pathogenesis of gastrointestinal autoimmune diseases. *Nat. Clin. Pract. Gastroenterol. Hepatol*. 2, 416-422 (PDF Download Available). Available from: <https://www.researchgate.net/publication/7502817> Fasano A Shea-

[Donohue T Mechanisms of disease the role of intestinal barrier function in the pathogenesis of gastrointestinal autoimmune diseases Nat Clin Pract Gastroenterol Hepatol 2 416-422](#) [accessed May 3, 2017].

- [Int J Inflam](#). 2010; 2010: 823710, *Peyer's Patches: The Immune Sensors of the Intestine*, Camille Jung,1, 2 Jean-Pierre Hugot,1, 2 and Frédéric Barreau
- <https://www.nature.com/news/2011/110921/full/news.2011.550.html>
- *Baillieres Clin Endocrinol Metab*. 1994 Jan;8(1):51-76. *Gastrointestinal neurotransmitters;McConalogue K1, Furness JB*.
- *FASEB J*. 2015 Apr; 29(4): 1395–1403. Published online 2014 Dec 30. doi: [10.1096/fj.14-259598](https://doi.org/10.1096/fj.14-259598) PMID: PMC4396604 *Gut microbes promote colonic serotonin production through an effect of short-chain fatty acids on enterochromaffin cells* [Christopher S. Reigstad](#),\* [Charles E. Salmons](#),\*
- *Front Cell Neurosci*. 2015; 9: 392. Published online 2015 Oct 14. doi: [10.3389/fncel.2015.00392](https://doi.org/10.3389/fncel.2015.00392) PMID: PMC4604320 *Breaking down the barriers: the gut microbiome, intestinal permeability and stress-related psychiatric disorders* [John R. Kelly](#),<sup>1,2</sup> [Paul J. Kennedy](#),<sup>1</sup> [John F. Cryan](#),<sup>1</sup>
- *Emerg (Tehran)*. 2016 Nov;4(4):171-183. *Gastrointestinal Headache; a Narrative Review* T Hoghani M, Rezaeizadeh H, Fazljoo SM, Keshavarz M
- *Curr Opin Gastroenterol*. 2006 Mar;22(2):140-6., *Intestinal absorption of water-soluble vitamins: an update.*, Said HM1, Mohammed ZM.
- *Singapore Med J*. 2000 Jun;41(6):255-8. *Normal bowel habits and prevalence of functional bowel disorders in Singaporean adults--findings from a community based study in Bishan*. Community Medicine GI Study Group. [Chen LY](#)<sup>1</sup>, [Ho KY](#), [Phua KH](#).
- <https://www.niddk.nih.gov/health-information/urologic-diseases/perineal-injury-males> *Perm J*. 2007 Fall; 11(4): 62–65. Published online Fall 2007. PMID: PMC3048443
- *Anal Fissure: A Common Cause of Anal Pain* [Herman Villalba](#), MD, [Sabrina Villalba](#), MD, and [Maher A Abbas](#), MD, FACS, FASCRC *Crit Care Med*. 1987 Jul;15(7):705-6.
- *Atrioventricular block secondary to straining*. [Mikhail MS](#), [Thangathurai D](#), [Viljoen JF](#), [Chandraratna PA](#). *Am J Pathol*. 2006 Dec; 169(6): 1901–1909. doi: [10.2353/ajpath.2006.060681](https://doi.org/10.2353/ajpath.2006.060681) PMID: PMC1762492
- *Molecular Basis of Epithelial Barrier Regulation From Basic Mechanisms to Clinical Application* [Jerrold R. Turner](#)
- *Mechanisms of disease: the role of intestinal barrier function in the pathogenesis of gastrointestinal autoimmune diseases*. [Fasano A](#)<sup>1</sup>, [Shea-Donohue T](#).
- <https://www.aarda.org/news-information/statistics/#1488234345468-3bf2d325-1052>
- *J Am Coll Nutr*. 2014;33(1):39-54. doi: 10.1080/07315724.2014.869996. *Non-celiac gluten sensitivity: literature review*. [Mansueto P](#)<sup>1</sup>, [Seidita A](#), [D'Alcamo A](#), [Carroccio A](#).
- Information adapted from <https://www.amymyersmd.com/2018/04/3-reasons-give-up-gluten-autoimmune-disease/>
- *Curr Opin Clin Nutr Metab Care*. 2013 Jul;16(4):434-9. doi: 10.1097/MCO.0b013e328361c8b8. *Sugar addiction: pushing the drug-sugar analogy to the limit*. [Ahmed SH](#)<sup>1</sup>, [Guillem K](#), [Vandaele Y](#).
- <http://wholehealthsource.blogspot.com/2012/02/by-2606-us-diet-will-be-100-percent.html>
- Source material was from the department of commerce and the US

- [Neuroscience](#). 2002;112(4):803-14. A high-fat, refined sugar diet reduces hippocampal brain-derived neurotrophic factor, neuronal plasticity, and learning. [Molteni R<sup>1</sup>](#), [Barnard RJ](#), [Ying Z](#), [Roberts CK](#), [Gómez-Pinilla F](#).
- [BMC Biol](#). 2012; 10: 42. Published online 2012 May 21. doi: [10.1186/1741-7007-10-42](#) PMCID: PMC3357317Q&A: 'Toxic' effects of sugar: should we be afraid of fructose? [Luc Tappy](#)
- [Open Heart](#). 2016; 3(2): e000469. Published online 2016 Aug 2. doi: [10.1136/openhrt-2016-000469](#) PMCID: PMC4975866 Added sugars drive nutrient and energy deficit in obesity: a new paradigm [James J DiNicolantonio<sup>1</sup>](#) and [Amy Berger<sup>2</sup>](#)
- [World J Gastroenterol](#). 2016 Aug 28;22(32):7353-64. doi: 10.3748/wjg.v22.i32.7353. Effects of different diets on intestinal microbiota and nonalcoholic fatty liver disease development. [Liu JP<sup>1</sup>](#), [Zou WL<sup>1</sup>](#), [Chen SJ<sup>1</sup>](#), [Wei HY<sup>1</sup>](#), [Yin YN<sup>1</sup>](#), [Zou YY<sup>1</sup>](#), [Lu FG<sup>1</sup>](#).
- [Nutr J](#). 2014; 13: 61. Published online 2014 Jun 17. doi: [10.1186/1475-2891-13-61](#) PMCID: PMC4074336 Fast food fever: reviewing the impacts of the Western diet on immunity [Ian A Myles<sup>1</sup>](#)
- [JAMA Intern Med](#). 2014 Apr;174(4):516-24. doi: 10.1001/jamainternmed.2013.13563. Added sugar intake and cardiovascular diseases mortality among US adults. [Yang Q<sup>1</sup>](#), [Zhang Z<sup>1</sup>](#), [Gregg EW<sup>2</sup>](#), [Flanders WD<sup>3</sup>](#), [Merritt R<sup>1</sup>](#), [Hu FB<sup>4</sup>](#).
- [Diabetes Care](#). 2010 Nov; 33(11): 2477–2483. Published online 2010 Aug 6. doi: [10.2337/dc10-1079](#) PMCID: PMC2963518 Sugar-Sweetened Beverages and Risk of Metabolic Syndrome and Type 2 Diabetes A meta-analysis
- <https://draxe.com/artificial-sweeteners/>
- Sleep Loss and Inflammation [Janet M. Mullington](#), Ph.D.,<sup>1</sup> [Norah S. Simpson](#), Ph.D.,<sup>1</sup> [Hans K. Meier-Ewert](#), M.D.,<sup>2</sup> and [Monika Haack](#), Ph.D.<sup>1</sup>
- [Mol Metab](#). 2016 Oct 24;5(12):1175-1186. eCollection 2016. Gut microbiota and glucometabolic alterations in response to recurrent partial sleep deprivation in normal-weight young individuals. [Benedict C<sup>1</sup>](#), [Vogel H<sup>2</sup>](#), et al. Eur
- [J Clin Nutr](#). 2016 Nov 2. doi: 10.1038/ejcn.2016.201. The effects of partial sleep deprivation on energy balance: a systematic review and meta-analysis. Al Khatib HK1, Harding SV1, Darzi J1, Pot GK1,2.
- [PLoS Med](#). 2004 Dec; 1(3): e62. Published online 2004 Dec 7. doi: [10.1371/journal.pmed.0010062](#) PMCID: PMC535701 Short Sleep Duration Is Associated with Reduced Leptin, Elevated Ghrelin, and Increased Body Mass Index [Shahrad Taheri<sup>1,3</sup>](#), [Ling Lin<sup>1</sup>](#), [Diane Austin<sup>2</sup>](#), [Terry Young<sup>2</sup>](#) and [Emmanuel Mignot<sup>1,4</sup>\\*](#)
- [Oxidative Medicine and Cellular Longevity](#) Volume 2017 (2017), Article ID 3831972, 8 pages <https://doi.org/10.1155/2017/3831972> Exercise Modifies the Gut Microbiota with Positive Health Effects Vincenzo Monda,<sup>1</sup> Ines Villano
- <https://www.hindawi.com/journals/omcl/2017/3831972/>
- <https://www.nhlbi.nih.gov/health/health-topics/topics/phys/recommend>
- [World J Gastroenterol](#). 2014 Oct 21; 20(39): 14126–14131. Published online 2014 Oct 21. doi: [10.3748/wjg.v20.i39.14126](#) PMCID: PMC4202343 PMID: [25339801](#) Impact of psychological stress on irritable bowel syndrome [Hong-Yan Qin](#), [Chung-Wah Cheng](#), [Xu-Dong Tang](#), and [Zhao-Xiang Bian](#)
- [World J Gastrointest Pathophysiol](#). 2013 Nov 15; 4(4): 108–118. Published online 2013 Nov 15. doi: [10.4291/wjgp.v4.i4.108](#) PMCID: PMC3829457 PMID: [24244879](#) Effects of occupational stress on the gastrointestinal tract [María-Raquel Huerta-Franco](#), [Miguel Vargas-Luna](#), [Paola Tienda](#), [Isabel Delgadillo-Holtfort](#), [Marco Balleza-Ordaz](#), and [Corina Flores-Hernandez](#)
- [J Physiol Pharmacol](#). 2011 Dec;62(6):591-9. Stress and the gut: pathophysiology, clinical consequences, diagnostic approach and treatment options. [Konturek PC<sup>1</sup>](#), [Brzozowski T](#), [Konturek SJ](#).

- [Adv Mind Body Med](#). 2017 Fall;31(4):10-25. The Effects of Stress and Meditation on the Immune System, Human Microbiota, and Epigenetics. [Househam AM](#), [Peterson CT](#), [Mills PJ](#), [Chopra D](#).
- [J Environ Public Health](#). 2012; 2012: 184745. Published online 2012 Feb 22. doi: [10.1155/2012/184745](#) PMID: PMC3312275 Arsenic, Cadmium, Lead, and Mercury in Sweat: A Systematic Review [Margaret E. Sears](#),<sup>1,2,\*</sup> [Kathleen J. Kerr](#),<sup>3,4</sup> and [Riina I. Bray](#)<sup>3,4</sup> [J Altern Complement Med](#). 2011 Dec; 17(12): 1175–1180.
- Detoxification in Naturopathic Medicine: A Survey [Jason Allen](#), ND, MPH,<sup>1,2</sup> [Melissa Montalto](#), MS,<sup>1</sup> [Jennifer Lovejoy](#), PhD,<sup>3</sup> and [Wendy Weber](#), ND, PhD, MPH<sup>4</sup>
- [Altern Ther Health Med](#). 2007 Mar-Apr;13(2):S154-6. Components of practical clinical detox programs--sauna as a therapeutic tool. [Crinnion W](#)<sup>1</sup>.
- <https://medlineplus.gov/salivaryglanddisorders.html>
- <https://www.cancer.org/treatment/survivorship-during-and-after-treatment/staying-active/nutrition/nutrition-during-treatment/dry-mouth-thick-saliva.html>
- [Can J Gastroenterol](#). 2007 Apr; 21(4): 241–244. PMID: PMC2657699 Oral manifestations of gastrointestinal diseases [Tom D Daley](#), DDS MSc FRCDC<sup>1</sup> and [Jerrold E Armstrong](#), DDS MSc FRCDC<sup>2</sup>
- [Buettner, Dan](#) (21 April 2009) [2008]. "Contents". *The Blue Zones: Lessons for Living Longer From the People Who've Lived the Longest* (First Paperback ed.). Washington, D.C.: National Geographic. p. vii. ISBN 978-1-4262-0400-5. OCLC 246886564. Retrieved 15 September 2009.
- [Am J Clin Nutr](#). 1989 Jan;49(1):97-105.Oral digestion of a complex-carbohydrate cereal: effects of stress and relaxation on physiological and salivary measures.[Morse DR](#)<sup>1</sup>, [Schacterle GR](#), [Furst L](#), [Zaydenberg M](#), [Pollack RL](#).
- [Gut](#). 2006 Mar; 55(3): 379. doi: [10.1136/gut.2005.075598](#) PMID: PMC1856099Chewing is an important first step in digestionMonitoring Editor: Robin Spiller [R Slim](#), [K Honein](#), [C Yaghi](#), [M Chemaly](#), [B Kheir](#), and [R Sayegh](#)
- [Gut](#). 1988 Mar; 29(3): 302–305. PMID: PMC1433604 Effect of meal temperature on gastric emptying of liquids in man. [W M Sun](#), [L A Houghton](#), [N W Read](#), [D G Grundy](#), and [A G Johnson](#)
- <http://www.mayoclinic.org/diseases-conditions/eosinophilic-esophagitis/basics/causes/con-20035681>
- <https://www.eatnakednow.com/13-signs-you-have-hypochlorhydria/>
- [World J Gastroenterol](#). 2015 Oct 28; 21(40): 11450–11457. Published online 2015 Oct 28. doi: 10.3748/wjg.v21.i40.11450, Dysbiotic infection in the stomach, Hisashi Iizasa, Shyunji Ishihara, Timmy Richardo, Yuichi Kanehiro, and Hironori Yoshiyama
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4616220/>
- [Baillieres Best Pract Res Clin Gastroenterol](#). 2000 Feb;14(1):147-59. How do NSAIDs cause ulcer disease?[Wallace JL](#)<sup>1</sup>.
- IMS Health Reports U.S. Prescription Sales Grew 3.8 Percent in 2007, to \$286.5 Billion Moderating Growth Reflects Impact of Patent Expirations, Fewer Product Approvals, Maturing Medicare Part D Program, and Safety Issues March 12, 2008 06:00 AM Eastern Daylight Time
- [Biochim Biophys Acta](#). 1991 Jun 18;1065(2):261-8.Omeprazole and bafilomycin, two proton pump inhibitors: differentiation of their effects on gastric, kidney and bone H(+)-translocating ATPases.[Mattsson JP](#)<sup>1</sup>, [Väänänen K](#), [Wallmark B](#), [Lorentzon P](#).
- [Curr Gastroenterol Rep](#). Author manuscript; available in PMC 2010 Apr 15. [Curr Gastroenterol Rep](#). 2008 Dec; 10(6): 528–534. PMID: PMC2855237NIHMSID: NIHMS189138 Pharmacology of Proton Pump Inhibitors [Jai Moo Shin](#), PhD and [George Sachs](#), DSc, MD



- <https://www.eatnakednow.com/13-signs-you-have-hypochlorhydria/> Review article: methods of measuring gastric acid secretion [T. Ghosh](#), [D. I. Lewis](#), [A. T. R. Axon](#), [S. M. Everett](#) First published: 24 January 2011
- <https://doi.org/10.1111/j.1365-2036.2010.04573.x> [Daryl DePestel](#); [Powel Kazanjian](#); [Sandro Cinti](#); et al. (2004). "Magnitude and Duration of Elevated Gastric pH in Patients ...". *Pharmacotherapy*. 24 (11): 1539–1545. doi:10.1592/phco.24.16.1539.50959. PMID 15537559.
- *Gut*. 1969 Mar; 10(3): 245–246. PMID: PMC1552825 PMID: [5781146](#) Use of the Heidelberg pH capsule in the routine assessment of gastric acid secretion. [B H Stack](#)
- Proton Pump Inhibitor Usage and the Risk of Myocardial Infarction in the General Population Nigam H. Shah , Paea LePendu , Anna Bauer-Mehren, et al. Published: June 10, 2015
- <http://dx.doi.org/10.1371/journal.pone.0124653>
- *J Pathol*. 2000 Feb;190(3):244-54. Nitric oxide in the pathogenesis of vascular disease. [Li H<sup>1</sup>](#), [Förstermann U](#).
- Proton Pump Inhibitors Accelerate Endothelial Senescence Gautham Yepuri, Roman Sukhovshin, Timo Z Nazari-Shafti, Michael Petrascheck, Yohannes T Ghebre, John P Cooke CIRCRESAHA.116.308807 Originally published May 10, 2016
- Cognitive impact after short-term exposure to different proton pump inhibitors: assessment using CANTAB software [Sanjida Akter](#),# [Md. Rajib Hassan](#),# [Mohammad Shahriar](#),# [Nahia Akter](#), [Md. Golam Abbas](#), and [Mohiuddin Ahmed Bhuiyan](#)
- Association of Proton Pump Inhibitors With Risk of Dementia A Pharmacoepidemiological Claims Data Analysis [Willy Gomm](#), PhD1; [Klaus von Holt](#), MD, PhD1; et al
- JASN Journal of the American Society of Nephrology Proton Pump Inhibitors and Risk of Incident CKD and Progression to ESRD [Yan Xie\\*](#), et al.
- Journal of Experimental Biology Regulation of the V-ATPase in kidney epithelial cells: dual role in acid–base homeostasis and vesicle trafficking [Dennis Brown](#), [Teodor G. Paunescu](#), [Sylvie Breton](#), [Vladimir Marshansky](#) Journal of Experimental Biology 2009 212: 1762-1772; doi: 10.1242/jeb.028803
- <https://www.livestrong.com/article/441098-what-to-eat-when-you-have-an-acidic-stomach/>
- *Mol Pharm*. Author manuscript; available in PMC 2014 Mar 8. Published in final edited form as: *Mol Pharm*. 2013 Nov 4; 10(11): 4032–4037. Published online 2013 Sep 10. doi: [10.1021/mp4003738](https://doi.org/10.1021/mp4003738) Gastric Re-acidification with Betaine HCl in Healthy Volunteers with Rabeprazole-Induced Hypochlorhydria [Marc Anthony R. Yago](#),<sup>1</sup> [Adam R. Frymoyer](#),<sup>2</sup> [Gillian S. Smelick](#),<sup>3</sup> [Lynda A. Frassetto](#),<sup>4</sup> [Nageshwar R. Budha](#),<sup>3</sup> [Mark J. Dresser](#),<sup>3</sup> [Joseph A. Ware](#),<sup>3</sup> and [Leslie Z. Benet](#)<sup>1</sup>.
- <https://www.niddk.nih.gov/health-information/digestive-diseases/acid-reflux-ger-gerd-adults/symptoms-causes>
- *Current Gastroenterology Reports* December 2010, Volume 12, [Issue 6](#), pp 448–457 Association of Long-Term Proton Pump Inhibitor Therapy with Bone Fractures and Effects on Absorption of Calcium, Vitamin B<sub>12</sub>, Iron, and Magnesium
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3831207/>
- *World J Gastroenterol*. 2013 Nov 14; 19(42): 7258–7266. Published online 2013 Nov 14. doi: [10.3748/wjg.v19.i42.7258](https://doi.org/10.3748/wjg.v19.i42.7258) PMID: PMC3831207 Diagnosis and treatment of pancreatic exocrine insufficiency [Björn Lindkvist](#)
- *West Afr J Med*. 2004 Jul-Sep;23(3):240-4. Faecal pancreatic elastase--1 a non invasive measure of exocrine pancreatic function. [Amanquah SD](#)<sup>1</sup>, [Darko R](#), [Maddy SQ](#), [Duah OA](#).

- Sudakin DL. Dietary aflatoxin exposure and chemoprevention of cancer: a clinical review. *J Toxicol Clin Toxicol*. 2003;41(2):195-204. Egner PA, Munoz A, Kensler TW. Chemoprevention with chlorophyllin in individuals exposed to dietary aflatoxin. *Mutat Res*. 2003;523-524:209-216.
- [“Apple Cider Vinegar Benefits & Cures: For ACV Weight Loss, Arthritis, Detox, Acid Reflux,” Paul Beaudette<sup>29, 23</sup> “Getting to the Core of Apple Cider Vinegar: The Ultimate Guide Book to Apple Cider Vinegar Health Benefits, Home Remedies and More,” Lulu.com<sup>30</sup> “Water, The Shocking Truth,” 2004<sup>31, 24</sup> “The Miracle of Lemons - Practical Tips for Health, Home & Beauty,” January 1, 2013](#)
- Genetics of Celiac Disease, Updated: Nov 10, 2016 Author: Alessio Fasano, MD; Chief Editor: Karl S Roth, MD
- <http://emedicine.medscape.com/article/1790189-overview>
- *Ann Clin Biochem*. 2000 Jul;37 ( Pt 4):512-9. Lactulose-mannitol intestinal permeability test: a useful screening test for adult coeliac disease. Johnston SD<sup>1</sup>, Smye M, Watson RG, McMillan SA, Trimble ER, Love AH.
- *Gastroenterology Volume 152, Issue 5*, April 2017, Pages 1100–1113. e12 Nutritional Wheat Amylase-Trypsin Inhibitors Promote Intestinal Inflammation via Activation of Myeloid Cells
- *Glob Adv Health Med*. 2014 May;3(3):16-24. doi: 10.7453/gahmj.2014.019. Herbal therapy is equivalent to rifaximin for the treatment of small intestinal bacterial overgrowth. Chedid V, Dhalla S, Clarke JO, Roland BC, Dunbar KB, Koh J, Justino E, Tomakin E, Mullin GE. PMID: 24891990 PMCID: PMC4030608 DOI: 10.7453/gahmj.2014.019
- *Acupunct Electrother Res*. 2011;36(1-2):19-64. Caprylic acid in the effective treatment of intractable medical problems of frequent urination, incontinence, chronic upper respiratory infection, root canal tooth infection, ALS, etc., caused by asbestos & mixed infections of *Candida albicans*, *Helicobacter pylori* & cytomegalovirus with or without other microorganisms & mercury. Omura Y<sup>1</sup>, O'Young B, Jones M, Pallos A, Duvi H, Shimotsuura Y.
- Clinical and Fecal Microbial Changes With Diet Therapy in Active Inflammatory Bowel Disease. Suskind DL<sup>1</sup>, Cohen SA, Brittnacher MJ, Wahbeh G, Lee D, Shaffer ML, Braly K, Hayden HS, Klein J, Gold B, Giefer M, Stallworth A, Miller SJ. *J Clin Gastroenterol*. 2016 Dec 27. doi: 10.1097/MCG.0000000000000772. [Epub ahead of print] PMID: 28030510 DOI: 10.1097/MCG.0000000000000772
- Modulation of immunity and inflammatory gene expression in the gut, in inflammatory diseases of the gut and in the liver by probiotics Julio Plaza-Diaz, Carolina Gomez-Llorente, Luis Fontana, and Angel Gil *World J Gastroenterol*. 2014 Nov 14; 20(42): 15632–15649.; Published online 2014 Nov 14. doi: 10.3748/wjg.v20.i42.15632; PMCID: PMC4229528
- Fiber and Prebiotics: Mechanisms and Health Benefits; Joanne Slavin; *Nutrients*. 2013 Apr; 5(4): 1417–1435. Published online 2013 Apr 22. doi: 10.3390/nu5041417; PMCID: PMC3705355
- Gibson G.R., Roberfroid M.B. Dietary modulation of the human colonic microbiota: Introducing the concept of prebiotics. *J. Nutr.* 1995;125:1401–1412.
- *J Med Food*. 2014 Dec 1; 17(12): 1261–1272. doi: [10.1089/jmf.2014.7000](https://doi.org/10.1089/jmf.2014.7000) PMCID: PMC4259177 The Gut Microbiome and the Brain [Leo Galland](#)
- *FEMS Microbiol Lett*. 2013 Mar;340(1):1-10. doi: 10.1111/1574-6968.12056. Epub 2012 Dec 17. Factors involved in the colonization and survival of bifidobacteria in the gastrointestinal tract. [González-Rodríguez I<sup>1</sup>](#), [Ruiz L](#), [Gueimonde M](#), [Margolles A](#), [Sánchez B](#).
- *Science*. 2011 Oct 7;334(6052):105-8. doi: 10.1126/science.1208344. Epub 2011 Sep 1. Linking long-term dietary patterns with gut microbial enterotypes. [Wu GD<sup>1</sup>](#), [Chen J](#), [Hoffmann C](#), [Bittinger K](#), [Chen YY](#), [Keilbaugh SA](#), [Bewtra M](#), [Knights D](#), [Walters WA](#), [Knight R](#), [Sinha R](#), [Gilroy E](#), [Gupta K](#), [Baldassano R](#), [Nessel L](#), [Li H](#), [Bushman FD](#), [Lewis JD](#).

- [Bioessays](#). 2014 Oct; 36(10): 940–949. Published online 2014 Aug 8. doi: [10.1002/bies.201400071](https://doi.org/10.1002/bies.201400071) PMID: PMC4270213 Is eating behavior manipulated by the gastrointestinal microbiota? Evolutionary pressures and potential mechanisms [Joe Alcock](#),<sup>1</sup> [Carlo C Maley](#),<sup>2),3),4)\*</sup> and [C Athena Aktipis](#)
- De Roest, *Int J Clin Prac*, 2013; Gibson, *J Gastroenterol Hepatol*, 2010; Gibson – *Am J Gastroenterol*, 2012; Ong, et al, *J Gas F*
- FODMAP downloadable charts can be found at <http://www.ibsdiets.org/fodmap-diet/fodmap-diet-chart/>
- *The Textbook of Functional Medicine. Chapter 28. Institute of Functional Medicine. 2005.*
- *Textbook of Medical Physiology, Guyton, 8<sup>th</sup> Edition*
- *Metabolism at a Glance, JG Salway, Blackwell Science 1994*