

NEW

# Biofilm Medicine

Points of view, diagnostics, therapy and checklists for Patients  
with chronic multisystem diseases by pathogens;

Biofilms and Cavete - diagnoses;

Literature - Collection

by

**Dr. med. Bernt – Dieter Huisman  
Internist, Environmental medicine**

**2019**

[http://www.erlebnishaft.de/new\\_biofilm\\_medicine.pdf](http://www.erlebnishaft.de/new_biofilm_medicine.pdf)  
[http://www.erlebnishaft.de/literature\\_new\\_biofilm\\_medicine.pdf](http://www.erlebnishaft.de/literature_new_biofilm_medicine.pdf)

## Table of contents

<b>Table of contents</b> .....	<b>2</b>
<b>1 Disclaimer</b> .....	<b>3</b>
<b>2 Literature</b> .....	<b>4</b>
2.1 Introduction .....	4
2.2 Controversies and treatment consent form .....	5
2.3 Symptoms, signs and pathogens at multisystem – diseases .....	5
2.4 Biological bases, vitality .....	5
2.5 Diversity, Pleomorphie, CWDs, Stress Granula, bacterial L-Formes .....	6
2.6 Biofilms and Quorum sensing .....	14
2.7 Anti – biofilm – medication .....	17
2.8 Horizontal gene transfer, Autoimmunity, Tumor neogenesis.....	20
2.9 Tetracyclines and Tumor therapy.....	22
2.10 Symbiosis, self organization, Nucleolinus, Patern matching .....	22
2.11 Anamnesis, physical examination, pathogens, antibiotics, costs .....	28
2.12 Cavete – Diagnoses.....	29
2.12.1 Fatigue without pain (CFS), Myalgic encephalomyelitis .....	29
2.12.2 Morgellons disease .....	32
2.12.3 Lichen sclerosus .....	33
2.12.4 Throat, nose, ears .....	34
2.12.5 Eyes.....	34
2.12.6 Encephalomyelitis disseminata, Multiple Sklerosis, MS.....	37
2.12.7 Amyotrophic Lateralsclerosis, ALS.....	39
2.12.8 Dementia, Alzheimer´s, Parkinson .....	41
2.12.9 Neurologic Patients .....	48
2.12.10 ADHS and psychiatric patients.....	50
2.12.11 Arthritis.....	54
2.12.12 Pneumologic .....	56
2.12.13 Digestive trakt .....	57
2.12.14 Leaky gut, Colitis, Hepatitis, Cholangitis .....	57
2.12.15 Nephrologic.....	59
2.12.16 Hämatologic .....	60
2.12.17 Angiologic, cardiologic .....	61
2.12.18 Cardiac stimulus conduction disease, cardiomyopathy.....	64
2.13 Infiltrative, destructive, tumorous, auto neogenesis .....	67
2.14 Laboratory tests and imaging procedures .....	68
2.15 Special risiks and contraindications, therapy options.....	68
2.16 Variants to combination – long-term – antibioses & adjuvants.....	69
2.17 Comment on the fees.....	69

### Target Groups:

Medical and biological professionals and students (health professionals and natural scientists), physicians and marketing managers (guideline creators), patients (affected and their organizations), scientists (basic researchers), appraisers, lawyers, politicians and interested lay people.

# 1 Disclaimer

According to the judgment of 12 May 1998 - 312 O 85/98 - "Liability for links", the Landgericht (LG) Hamburg, Germany has been made the following statement: The author distance himself expressly from all contents of linked external Internet pages and do not endorse such content. This declaration applies to all links and their secondary contents.

## Terms of Use and Disclaimer

The contribution cannot replace a visit to the doctor. The contribution is solely the personal opinion of the author. This text was prepared with great care. However, no liability can be accepted for its accuracy, especially in relation to dosages by the authors.

Under no circumstances the author of the article is to be held liable for any loss or damage that may arise to the user in that he relies on information that he received in the context of the use of the contribution.

<http://www.wwwarchiv.de/wwwarchiv/anfang/all/recht.html>

The author has no financial conflicts. The article was prepared without any financial aid. All figures and tables in this work and all contents of the domains

<http://www.erlebnishaft.de> , <http://www.xerlebnishaft.de> and <http://www.kabilahsystems.de>

were created by the author himself.

Contact address:

Dr. med. Bernt-Dieter Huismans

Am Haldenberg 24, 74564 Crailsheim, Germany, Phone: +49 (0)7951 26330

Email: [BUuismans@t-online.de](mailto:BUuismans@t-online.de)

<http://www.Huismans.click>

## 2 Literature

### 2.1 Introduction

- Harborne JB (1995) Ökologische Biochemie. Spektrum Akademischer Verlag Heidelberg, Berlin, Oxford.
- Wheeler JA <https://www.youtube.com/watch?v=AyZLFXS7Tfc>
- Huisman BD (2007) <https://www.grin.com/document/71284>
- Huisman BD (2008) Langzeitbehandlung mit Antiinfektiva bei persistierender Borreliose mit Borrelien-DNA-Nachweis durch PCR Mit Hinweisen auf Antiinfektiva-Kombinationen im Anhang. Wissenschaftliche Studie. <http://www.grin.com/de/e-book/117294/langzeitbehandlung-mit-antiinfektiva-bei-persistierender-borreliose-mit>
- Klemann W, Huisman BD, Heyl S (2011) Prolonged antibiotic therapy in PCR confirmed persistent Lyme disease. Grin Verlag, ISBN 978-3-640-82803-6 Prolonged antibiotic therapy in PCR confirmed persistent Lyme disease. Anchor Academic Publishing 2014, ISBN 978-3-95489-241-9  
[https://www.google.de/search?q=Prolonged+antibiotic+therapy+in+PCR+confirmed+persistent+Lyme+disease.&hl=de&btnG=Google+Search&qws\\_rd=ssl](https://www.google.de/search?q=Prolonged+antibiotic+therapy+in+PCR+confirmed+persistent+Lyme+disease.&hl=de&btnG=Google+Search&qws_rd=ssl)
- Flemming HC, Wingender J, Szewzyk, U (Eds.) (2011) Biofilm Highlights (Springer Series on Biofilms, Band 5). <https://www.springer.com/de/book/9783642199394>
- Huisman BD (2012) Bakterielle Stress-Varianten, Persistier, Eberth-Koch'sche Varianten, bakterielle L-Formen, filtrierbare Bakterien, V.B.N.C. (Viable But Non Cultivable) forms [http://en.wikipedia.org/wiki/L-form\\_bacteria](http://en.wikipedia.org/wiki/L-form_bacteria), langsam wachsende Bakterienpopulationen, Bakterielle Yin-Yang Varianten nach Zhang, einschl. Nanobakterien / Nanoben. <http://www.erlebnishaft.de/stressvar1.pdf>  
<http://www.erlebnishaft.de/stressvar2.pdf>
- Huisman BD (2014) Abwehr- und Escape- Mechanismen der Borrelien gegen das menschliche Immunsystem und gegenüber Antibiotika und Chemotherapeutika. Warum Borrelien infektiös bleiben trotz intensiver antibiotischer Behandlung <http://www.xerlebnishaft.de/escape.pdf>
- Huisman BD, Klemann W (2015) Antibiotika Langzeit-Therapie bei chronischer Lyme-Borreliose mit Borrelien DNA Nachweis durch PCR: Intensivbehandlung, Kombinations-Behandlung, Langzeitbehandlung. Bachelor + Master Publishing. ISBN-10: 3956842588 ISBN-13: 978-3956842580  
<https://www.google.de/search?hl=de&q=Antibiotika+Langzeittherapie+bei+chronischer+Lyme-Borreliose+mit+Borrelien+DNA-Nachweis+durch+PCR:+Intensivbehandlung,+Kombinationsbehandlung,+Langzeitbehandlung&spell=1&sa=X&ved=0ahUKEWjY9fHAisHiAhUJ3OAKHfaKBEIQBQqpKAA&biw=1600&bih=736>
- Huisman (2015) The small Diagnostic - Therapy - Booklet on Borrelia and Co – Infections for Clinicians and Practitioners. eBook from the Internet. Tables, Comments, Literature. [http://www.erlebnishaft.de/inhalt\\_eng.pdf](http://www.erlebnishaft.de/inhalt_eng.pdf)
- Hübner A, Huisman BD (2016) Thoughts and questions of a clinician related to the infection with borrelia and co-infections. <http://tinyurl.com/zjm7gle> (Deutsch entspr.) <http://tinyurl.com/okf2zzx>  
<http://www.grin.com/en/e-book/313377/thoughts-and-questions-of-a-clinician-related-to-the-infection-with-borrelia>
- Taking A Stand 4 Lyme (2018) <https://www.youtube.com/watch?v=0a3sBmlERQo&feature=youtu.be>
- „In Stand4Lyme Foundation's video, scientists tackle the Lyme disease Epidemic. Experts address the serious consequences of Lyme and tick-borne diseases, an increasing source of morbidity and mortality worldwide. Stand4Lyme makes a clear business case for pharmaceutical support and federal research funding to develop reliable diagnostic tools and accessible effective medical treatment. The goal of this video is to help educate all stakeholders from a scientific perspective and garner increased government support and funding.“
- GOOGLE (2019) « Cavete Diagnosen »  
[https://www.google.de/search?hl=de&biw=1600&bih=736&ei=f41RXCpNs-m1fAPk6mJ-AM&q=cavete+diagnosen&oq=cavete+diagnosen&gs\\_l=psy-ab.3...38210.62585..65894...0.0..102.515.5j1.....0....1..qws-wiz.....33i160.9GaXx1J1fGc](https://www.google.de/search?hl=de&biw=1600&bih=736&ei=f41RXCpNs-m1fAPk6mJ-AM&q=cavete+diagnosen&oq=cavete+diagnosen&gs_l=psy-ab.3...38210.62585..65894...0.0..102.515.5j1.....0....1..qws-wiz.....33i160.9GaXx1J1fGc)
- GOOGLE (2019) « Chronic Lyme Disease ».  
<https://www.google.de/search?q=chronic+lyme+disease&hl=de&ei=LYxRXOCrN5mj1fAP9ouRqAM&start=40&sa=N&ved=0ahUKEwigyqm7tZXgAhWZURUIHfZFBdu4HhDy0wMlfw&biw=1600&bih=736>
- Entdeckung und Chronologie der Lyme-Borreliose <https://borreliose-zecken-ms.de/chrono.html>
- Die BCA-clinic Augsburg <https://www.bca-clinic.de/>
- IMD Labor Berlin (2019) Labordiagnostik bei chronisch entzündlichen Multisystem - Erkrankungen. <https://www.imd-berlin.de/fachinformationen/diagnostikinformationen/entzuendungsdiagnostik-bei-multisystemerkrankungen.html>
- Carr S (2019) Unexplained Symptoms: When Diagnostic Uncertainty Becomes a Diagnosis. <https://www.improvediagnosis.org/improvedx-july-2019/unexplained-symptoms-when-diagnostic-uncertainty-becomes-a-diagnosis/>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.2 Controversies and treatment consent form**

<http://www.bmj.com/content/312/7023/71>

<http://www.dcsience.net/sackett-BMJ-1996.pdf>

[http://www.knihovna.upol.cz/fileadmin/user\\_upload/LF/IC/LBFVCA61/Definice\\_EBM\\_Sackett\\_1996\\_.pdf](http://www.knihovna.upol.cz/fileadmin/user_upload/LF/IC/LBFVCA61/Definice_EBM_Sackett_1996_.pdf)

[http://www.kabilahsystems.de/ko-erreg\\_eupd1.pdf](http://www.kabilahsystems.de/ko-erreg_eupd1.pdf)

Feder HM, Johnson BJB, O'Connell S et al. (2007) [A Critical Appraisal of "Chronic Lyme Disease"](#) (PDF). *NEJM*. 357 (14), 1422–30. doi:10.1056/NEJMra072023. PMID 17914043.

Auwaerter PG (2007) [Point: antibiotic therapy is not the answer for patients with persisting symptoms attributable to lyme disease](#). *Clin Infect Dis*. 15, 45(2), 143-8. DOI:10.1086/518854

Stricker RB (2007) [Counterpoint: Long-Term Antibiotic Therapy Improves Persistent Symptoms Associated with Lyme Disease](#). *Clin Infect Dis*. 15, 45(2), 149-57. doi: 10.1086/518853

Baker, PJ (2010) Chronic Lyme disease: in defense of the scientific enterprise. *The FASEB Journal*. 24 (11), 4175–4177. doi:10.1096/fj.10-167247. PMID 20631327.

Hansmann Y, Cazenave-Roblot F, Weinbreck P, Michelet C, Caumes E. (2015) [Maladie de Lyme : où est la controverse ?](#) *Presse Med*. 44(7-8), 697-9. doi: 10.1016/j.lpm.2015.06.001

Perronne C (2015) [Critical review of studies trying to evaluate the treatment of chronic Lyme disease](#). *Presse Med*. 44(7-8), 828-31. doi: 10.1016/j.lpm.2015.06.002

McSweegan, Edward. (2017) [Lyme Disease: Questionable Diagnosis and Treatment. Quackwatch.](#)

Kladetzky R-G (2018) Herausforderung chronische Borreliose – eine Übersicht für den Gutachter. *MedSach* 114 3/2018, 128–137 <http://docplayer.org/80948874-Herausforderung-chronische-borreliose-eine-uebersicht-fuer-den-gutachter.html>

Peretti-Watel P, Ward J, Lutaud R, Seror V (2019) Lyme disease: Insight from social sciences *Maladie de Lyme: le regard des sciences sociales. Médecine et Maladies Infectieuses*.

<https://doi.org/10.1016/j.medmal.2018.12.005>

<https://www.sciencedirect.com/science/article/pii/S0399077X18306802?via=ihub>

Gentilini M, Bricaire F (2019) Chronic Lyme disease: A scam that should be condemned! *Med Mal Infect*, pii: S0399-077X(19)30003-4. doi: 10.1016/j.medmal.2019.01.001. <https://doi.org/10.1016/j.medmal.2019.01.001>

« Chronic Lyme disease” rather reflects the perception of one’s own multiple difficulties as well as the problems of our society. ... This scientifically unacceptable and medically detrimental downward spiral must be condemned fiercely. All infectious disease specialists must counter the breakthrough of these violent and even mafia groups (looking for judicialization and financial compensation) as they do not hesitate to jeopardize the life of patients who are looking for an explanation to their illness. Patients are victims of their symptoms as well as victims of unnecessary and useless treatments and associated adverse events. It is unfortunate that some physicians, eager for fame and increased means, are playing along as this is highly detrimental to patients. We must solemnly warn national authorities of the risk incurred: they are on the verge of unconsciously moving from timely indulgence to fraudulent complicity under the pressure of dissenting groups. Wanting to please everyone while not meeting anyone’s expectations does not ensure the patients’ protection. »

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.3 Symptoms, signs and pathogens at multisystem – diseases**

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.4 Biological bases, vitality**

Huismans BD (2007) *Nullquantum, Zahlensymbolik und Struktur*. Grin Verlag

<https://www.grin.com/document/80450>

Huismans BD (2007) *Lebendigkeit - Selbstorganisation - Morphogenese: 5. Hauptsatz der Thermodynamik, das Phanes Sound Theorem*. Grin Verlag

<https://www.grin.com/document/71284> [https://www.researchgate.net/publication/200152599\\_Lebendigkeit-](https://www.researchgate.net/publication/200152599_Lebendigkeit-Selbstorganisation-)

[Morphogenese 5 Hauptsatz der Thermodynamik das Phanes Sound Theorem/download](#)  
[www.grin.com/document/432181](http://www.grin.com/document/432181)

Cavete – Diagnoses [http://www.erlebnishaft.de/cavete\\_diagnosen.pdf](http://www.erlebnishaft.de/cavete_diagnosen.pdf)

Cavete – Diagnoses <http://www.erlebnishaft.de/kommentalternativ.pdf>

Danger Model [http://www.erlebnishaft.de/danger\\_model.pdf](http://www.erlebnishaft.de/danger_model.pdf)  
 Symbiosis <http://www.erlebnishaft.de/symbiogenese.pdf>  
 Self organization [http://www.erlebnishaft.de/selbst\\_muster\\_nano.pdf](http://www.erlebnishaft.de/selbst_muster_nano.pdf)  
 Gene transfer <http://www.erlebnishaft.de/genstransfer.pdf>  
 Prototyposis [Thomas Görnitz. https://anthrowiki.at/Prototyposis](https://anthrowiki.at/Prototyposis) <https://www.springerprofessional.de/prototyposis-eine-einfuehrung/16141126>  
 Dantzer et al. (2017) Inflammation and Depression. Springer International  
 Eisendle K et al. (2007) Focus floating microscopy „gold standard“ for cutaneous Borreliosis? Am J Clin Pathol. 127, 213-21.  
 Häupl T et al. (1993) Persistence of Borrelia burgdorferi in ligamentous tissue from a Patient with chronic Lyme borreliosis. Arthritis & Rheumatism; 36(11), 1621-1626.  
 Hodciz E et al. (2008) Persistence of Borrelia burgdorferi following Antibiotic Treatment in Mice. Antimicrobial Agents and Chemotherapy. 1728-1736.  
 Middlevee M et al. (2018) doi:10.20944/preprints201803.0062.v1  
 Miklossy J et al. (2008) Persisting atypical and casting forms of Borrelia burgdorferi and local inflammation in Lyme neuroborreliosis. J Neuroinflammation. 40(5), 1742-2094  
 Müller K (2012) Damage of Collagen and Elastic Fibres by Borrelia Burgdorferi – Known and New Clinical and Histopathological Aspects. The Open Neurol J. 6, (Suppl.1-M11) 179 – 186.  
 Preac-Mursic V. et al. (1989) Survival of Borrelia burgdorferi in antibioticly treated patients with Lyme Borreliosis. Infection; 17, 355-359.  
 Strle F (2015) Influence of borrelia species on clinical presentation of Lyme Borreliosis. Nationales Lyme-Borreliose-Symposium, Erfurt.

[Back](#)

Windows Alt + left arrow  
 Apple to start Fn + left arrow

## **2.5 Diversity, Pleomorphie, CWDs, Stress Granula, bacterial L-Formes**

Löhnis F (1916) Life cycles of bacteria. J. Agric. Res. 6, 675-702.  
 Almquist E (1922) Variation and life cycles of pathogenic bacteria. J.Infect.Dis. 31, 483-493  
 Relman DA (1999) The search for unrecognized pathogens. Science 284, 1308-1310  
 Wainwright M (1999) Nanobacteria and associated elementary bodies in human disease and cancer. Microbiology 145, 2623-2624  
 Klieneberger E (1931) Die heutigen Auffassungen der verschiedenen Formen der Bakterienzellen einer Art. Klinische Wochenschrift. 10, 31ff <http://link.springer.com/article/10.1007%2FBF01749944#page-1>  
 Klieneberger-Nobel E (1947) Morphological appearances of various stages in B. proteus and coli. J. Hyg., Camb., 45, 410.  
 Klieneberger-Nobel L (1949 a) Origin, development and significance of L-forms in bacterial cultures. J. gen. Microbiol. 3, 434.  
 Klieneberger-Nobel L (1949 b) On Streptobacillus moniliformis and the filtrability of its L-form. J. Hyg., Camb. 47, 393.  
 Klieneberger-Nobel E (1949) Origin, development and significance of L forms in bacterial cultures. J. Gen. Mikrobiol. 3, 434-442  
 Klieneberger-Nobel E (1951) The L-cycle: a Process of Regeneration in Bacteria. Journal of general microbiology, 5(3), 525-30. <http://mic.sgmjournals.org/content/5/3/525.full.pdf>  
 Klieneberger-Nobel E (1951). [Filterable forms of bacteria](#). Bacteriol Rev, 15(2), 77-103.  
 Klieneberger-Nobel E (1960) L Forms of bacteria. Bacteriol.Rev.Vol.1: Structure,Gunsalus,I.C.and Stanier R.Y. Eds., Academic Press, NY 361  
 Relman DA (1999) The search for unrecognized pathogens. Science 284, 1308-1310  
 Wainwright M (1999) Nanobacteria and associated elementary bodies in human disease and cancer. Microbiology 145, 2623-2624  
[Kendall AI.](#) (1931) OBSERVATIONS UPON THE FILTERABILITY OF BACTERIA, INCLUDING A FILTERABLE ORGANISM OBTAINED FROM CASES OF INFLUENZA. Science 74(1910),129-39. <http://www.ncbi.nlm.nih.gov/pubmed/17782489>  
 “1. The isolation of a filter-passing diplococcus from the blood of certain cases of influenza by means of a special cultural medium is described. The experimental effects of this organism, while in the filterable state, upon rabbits, is discussed. 2. A procedure is formulated for inducing at will both a filterable and a non-filterable state in bacteria. Mention is made of a series of experiments in which both the filterable and the non-filterable state has thus been induced in a series of well-known bacteria comprising a variety of types. 3. It is postulated that a majority, if not all, known bacteria can and do exist in a filterable and in a non-filterable state. 4. A preliminary report of the isolation of microbes in the blood, not only of cases



of influenza, but also from common cold, rheumatic fever, arthritis, from Staphylococcus bacteriophage and Besredka's Staphylococcus Antivirus is presented in evidence of the ubiquity of the procedure. 5. An explanation of the chemical basis for the existence of bacteria, both in the filterable and non-filterable states, in the animal and human body, and in culture, is proffered. 6. The relation of this chemical concept to microbial infection, and the state of microbes in the body during infection is discussed."

Dienes, L (1947). Further observations on the reproduction of bacilli from large bodies in Proteus cultures. Proc Soc Exp Biol Med, 66, 97-98.

Dienes L, Weinberger HJ (1951) The L forms of bacteria. Bacteriol. Rev. 15, 245-283.

FLEMING A, VOUREKA A, KRAMER IRH, HUGHES WH (1950) The morphology and motility of Proteus vulgaris and other organisms cultured in the presence of penicillin. J. gen. Microbiol. 4, 257.

DELAMATER ED, HAANESM H, WIGGALL RH, PILLSBURY DM (1951) STUDIES ON THE LIFE CYCLE OF SPIROCHETES. VIII. SUMMARY AND COMPARISON OF OBSERVATIONS ON VARIOUS ORGANISMS. THE JOURNAL OF INVESTIGATIVE DERMATOLOGY 16, 231-56 <http://lymerick.net/1951-Delamater.htm>

Vigouroux J, Hannoun C (1956) [Spontaneous appearance in vivo of L forms of bacteria; their possible importance in infectious pathology](#) Comptes rendus hebdomadaires des séances de l'Académie des sciences. 242(21), 2603-2606.

Hannoun C, Vigouroux J (1957) [Study of L forms of bacteria appearing spontaneously in vivo. I. Biological properties and pathogenic power](#) Annales de l'Institut Pasteur. 91(6), 912-927.

Hannoun C, Vigouroux J (1957) [Study of L forms of bacteria appearing spontaneously in vivo. II. Peculiar character of granular elements](#) Annales de l'Institut Pasteur. 92(1), 112-122.

Hannoun C, Vigouroux J, Levaditi J, Nazimoff O (1957) [L forms of bacteria appearing spontaneously in vivo. III. Comparative histopathology of lesions induced by normal bacteria and their modified forms](#) Annales de l'Institut Pasteur. 92(2), 231-8.

Hannoun C, Vigouroux J, Schneider J (1957) [Isolation of granular forms of bacteria in two cases of malignant endocarditis with negative or becoming negative hemoculture.](#) La Presse medicale 65(72), 1608-1611

Pratt B (1966) Cell-wall deficiencies in L-forms of Staphylococcus aureus. J Gen Microbiol, 42,115-22

Charache P (1968) Atypical bacterial forms in human disease, in Microbial Protoplasts, Spheroplasts, and L-Forms, Guze LB, Ed., Williams & Wilkins, Baltimore, 484-494

Mattman LH (1968) L forms isolated from infections. In Microbiol Protoplasts, Spheroplasts and L-Forms. Guze LB, Ed., Williams & Wilkins, Baltimore, 472-483

McDermott W (1969) Microbial persistence. Harvey Lectures 63, 1-31

[Feingold DS](#) (1969) Biology and pathogenicity of microbial spheroplasts and L-forms. N Engl J Med. 281(21), 1159-70. <http://www.ncbi.nlm.nih.gov/pubmed/4899869>

Charache P (1970) Cell wall defective bacterial variants in human disease. Ann. N.Y. Acad. Sci. 174, 903-911

Butler HM, Blakey JL (1975) [A review of bacteria in L-phase and their possible clinical significance.](#) The Med. J. of Australia, 2(12), 463-7.

Domingue GJ (ed.) Cell Wall Deficient Bacteria: Basic Principles and Clinical Significance. Addison Wesley Publishing Co., Reading, PA, USA

Domingue GJ (1995) Electron dense cytoplasmic particles and chronic infection: a bacterial pleomorphy hypothesis. Endocytobiosis Cell Res 11, 19-40

Domingue GJ, Woody H (1997) [Bacterial persistence and expression of disease.](#) Clin. Microbiol. Rev., 10(2), 320-344. [Full PDF](#)

Domingue GJ (2010) Demystifying Pleomorphic Forms in Persistence and Expression of Disease: Are They Bacteria, and Is Peptidoglycan the Solution? Discov Med 10(52), 234-246

<http://www.discoverymedicine.com/Gerald-J-Domingue/2010/09/23/demystifying-pleomorphic-forms-in-persistence-and-expression-of-disease-are-they-bacteria-and-is-peptidoglycan-the-solution/>

Gumpert J, Hoischen C (1998) Use of cell wall-less bacteria (L-forms) for efficient expression and secretion of heterologous gene products. Current Opinion in Biotechnology 9 (5), 506–9. doi:10.1016/S0958-1669(98)80037-2. PMID 9821280.

Kajander EO, Ciftcioglu N. (1998) Nanobacteria: an alternative mechanism for pathogenic intra- and extracellular calcification and stone formation. Proc. Nat. Acad. Sci. 95, 8274-8279. [Full text](#)

Ciftcioglu N, Kajander EO (1998) Interaction of nanobacteria with cultured mammalian cells. Pathophysiology 4, 259–270. [View Article](#) [PubMed/NCBI](#) [Google Scholar](#)

Uwins, P et al. (1998). [Novel nano-organisms from Australian sandstones, American Mineralogist.](#) 83, 1541–1550. <http://www.microscopy-uk.org.uk/nanobes/nanopaper.html>.

<http://www.answers.com/topic/nanobe#ixzz3Bm2euLKY>

Mattman LH (2001). [Cell Wall Deficient Forms: Stealth Pathogens.](#) CRC Press.

<http://www.youtube.com/watch?v=WozrCFW0mRM>

Mattman LH (2009). Cell Wall Deficient Forms: Stealth Pathogens. CRC Press. ISBN-10: 0849335787 ISBN-

- 13: 978-0849335785 <http://www.amazon.ca/Cell-Wall-Deficient-Forms-Pathogens/dp/0849335787>
- Young D, Hussell T, Dougan G. (2002) Chronic bacterial infections: living with unwanted guests. *Nat Immunol.* 3(11), 1026-32.
- Monack DM, Mueller A, Falkow S (2004) Persistent bacterial infections: the interface of the pathogen and the host immune system. *Nat. Rev. Microbiol.* 2, 747–765
- Onwuamaegbu ME, Belcher RA, Soare C. (2005) Cell Wall-deficient Bacteria as a Cause of Infections: a Review of the Clinical Significance. *The Journal of International Medical Research.* 33,1-20  
<http://www.ncbi.nlm.nih.gov/pubmed/15651712>
- Lewis K (2005) Persister cells and the riddle of biofilm survival. *Biochemistry (Mosc).* 70(2), 267-74.  
<http://www.ncbi.nlm.nih.gov/pubmed/15807669>
- Lewis K (2007) Persister cells, dormancy and infectious disease. *Nature Publishing Group* 5, 48-56  
<http://www.northeastern.edu/adc/publications/KL2007Pers.pdf>
- Lewis K (2010) Persister Cells. *Annu Rev Microbiol.* 64, 357-372. [PDF]  
<http://www.ncbi.nlm.nih.gov/pubmed/20528688>
- Margulis L, Maniatis A, MacAllister J et al. (2009) Position paper. Spirochete round bodies Syphilis, Lyme disease & AIDS: Resurgence of „the great imitator“? *SYMBIOSIS* 47, 51-58
- Dworkin J, Shah IM (2010) Exit from dormancy in microbial Organisms. *Macmillan Publishers Limited* 8, 890-896 [www.nature.com/reviews/microLi](http://www.nature.com/reviews/microLi)
- Dawson CC, Intapa C, Jabra-Rizk MA (2011) “Persisters”: Survival at the Cellular Level. *PLoS Pathog* 7(7), e1002121. doi:10.1371/journal.ppat.1002121  
<http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1002121>
- Errington J (2013) L-form bacteria, cell walls and the origins of life. *Open Biol* 3, 120143. doi: 10.1098/rsob.120143 <http://rsob.royalsocietypublishing.org/content/3/1/120143.full.pdf+html>
- Germain E et al. (2013) The molecular mechanism of bacterial persistence by HipA. *Molecular Cell*, 52, 248-54 <http://www.the-scientist.com/?articles.view/articleNo/38693/title/Bacterial-Persisters/>
- Wood TK, Knabel SJ, Kwan BW (2013) Bacterial Persister Cell Formation and Dormancy *Appl. Environ. Microbiol.* 79, 7116-7121 [Abstract Full Text Full Text \(PDF\)](#) 
- Zhang Y (2014) Persisters, persistent infections and the Yin–Yang model. *Emerging Microbes & Infections* 3, e3; doi:10.1038/emi.2014.3 Published online 8 January 2014  
<http://www.nature.com/emi/journal/v3/n1/full/emi20143a.html>  
<http://www.nature.com/emi/journal/v3/n1/pdf/emi20143a.pdf>
- Meriläinen L, Herranen A, Schwarzbach A, Gilbert L. (2015) Morphological and biochemical features of *Borrelia burgdorferi* pleomorphic forms. *Microbiology* 161, 516-27.  
<http://www.ncbi.nlm.nih.gov/pubmed/25564498>  
[http://www.microbiologyresearch.org/docserver/fulltext/micro/161/3/516\\_mic000027.pdf?expires=1455702503&id=id&accname=quest&checksum=EC90359881EEF900830727D16B2F8CBE](http://www.microbiologyresearch.org/docserver/fulltext/micro/161/3/516_mic000027.pdf?expires=1455702503&id=id&accname=quest&checksum=EC90359881EEF900830727D16B2F8CBE)
- Meriläinen L, Brander H, Herranen A, Schwarzbach A, Gilbert L (2016) Pleomorphic forms of *Borrelia burgdorferi* induce distinct immune responses. *Microbes Infect.* pii: S1286-4579(16)30029-6. doi: 10.1016/j.micinf.2016.04.002. <http://www.ncbi.nlm.nih.gov/pubmed/27139815>
- „We confirmed that spirochetes and round bodies present different protein profiles and antigenicity. In a Western blot analysis Lyme disease patients had more intense responses to round bodies when compared to spirochetes. These results suggest that round bodies have a role in Lyme disease pathogenesis.“
- Sharma B, Brown AV, Matluck NE, Hu LT, Lewis K. (2015) *Borrelia burgdorferi*, the causative agent of Lyme disease, forms drug-tolerant persister cells. *Antimicrob Agents Chemother* 59, 4616-24. <http://aac.asm.org/content/early/2015/05/20/AAC.00864-15.abstract>  
<http://aac.asm.org/content/59/8/4616.full>  
<http://aac.asm.org/content/early/2015/05/20/AAC.00864-15.full.pdf+html>
- Robert A. Fisher RA, Bridget Gollan B, Sophie Helaine S (2017) Persistent bacterial infections and persister cells. *Nature Reviews Microbiology* 15, 453–464 doi:10.1038/nrmicro.2017.42  
Published online. <https://www.ncbi.nlm.nih.gov/pubmed/28529326>
- Mycobacteria**
- Fontes A. (1910) Bemerkungen über die Tuberkulose Infektion und ihr Virus. *Mem. Inst. Oswaldo Cruz*, 2, 141-146
- Calmette A, Valtis J. (1926) Virulent filterable elements of tubercle bacillus. *Ann. Med.* 19, 553
- Lucksch F. (1931) Körnchenformen und Filtrierbarkeit des Tuberkelbazillus. *Beitr. Klein. Tuberk.* 77, 56-59
- Bernstein. (1933) Unbekannte Formelemente im Sputum von Tuberkulosekranken. *Beitr. Klin. Tuberk.* 82, 504-505.
- Bassermann FJ (1955) Die L-form des Tuberkuloseerregers in elektronoptischer Darstellung. *Beitr. Klein. Tuberk.* 113, 134-135
- Mattman LH, Tunstall LH, Mathews WW, Gordon DL (1960) L variation in mycobacteria. *Am. Rev. Respir. Dis.*



82, 102-211

Korsak T. (1975) Occurrence of L forms in a case of generalized mycobacteriosis due to *Mycobacterium scrofulaceum*. *Acta Tuberc. Pneumol. Belg.* 66, 445-469

Takahashi S (1979) L phase growth of *Mycobacteria*. 1. Cell wall deficient form of *Mycobacteria*. *Kekkaku*, 54, 63-70

Judge MS, Mattman LH (1982) Cell wall deficient mycobacteria in tuberculosis, sarcoidosis and leprosy. In *Cell Wall Deficient Bacteria*, Domingue G. J. Ed., Addison-Wesley, Reading, MA, 257-298

Golyshevskaya VI, Zemskova ZS, Kovrolev MB. (1984) Characteristics of the filterable forms of *Mycobacterium tuberculosis* and their pathological importance. *Zh. Microbiol. Epidemiol. Immunobiol.* 6, 23-27  
Zemskova ZS et al. (1985) Generalized TB caused by L forms of TB *Mycobacteria* in a child. *Probl. Tuberk.* 2, 64-66


Berezowsky BA, Salobai R. (1988) Role of mycobacterial L variants in development and progress of pulmonary tuberculosis relapses. *Problem Tuberk.* 4, 32-35

Biron MG, Soloveva IP. (1989) Acute hematogenic generalization of tuberculosis caused by L forms of *Mycobacteria*. *Probl. Tuberk.* 8, 75-76

Zhang DR. (1993) Clinical and epidemiological significances of L forms of *Mycobacterium tuberculosis*. *Chin. J. Tuberc. Respir. Dis.* 16(3), 181-183

Dorozhkova IR, Zamskova ZS, Krudu VN et al. (1995) Endogenous reactivation of tuberculosis as a result of reversion of persistent mycobacterial L-forms. *Probl. Tuberk.* 3, 43-46

Wakamoto Y, Dhar N, Chait R, Schneider K1, Signorino-Gelo F, Leibler S, McKinney JD (2013) Dynamic Persistence of Antibiotic-Stressed *Mycobacteria*. *Science* 339(6115) 91-95 DOI: 10.1126/science.1229858

[Abstract](#) [Full Text](#) [Full Text \(PDF\)](#) 

### **Spirochetes**

Warthin AS, Olson RE (1930) The granular transformation of *Spirochaeta Pallida* in aortic focal lesions. *Am J Syphilis* 14, 433-437

MacDonald AB, Berger BW, Schwan TB (1990) Clinical Implications of Delayed Growth of the Lyme Borreliosis Spirochete, *Borrelia burgdorferi*. *Acta Tropica* 48, 89-94.

Aberer E (1996) Heterogeneity of *Borrelia burgdorferi* in the skin. *Am J Dermatopathology*, 18(6), 571-9

Aberer E (1997) Why is chronic Lyme borreliosis chronic? *Clinical Infectious Diseases*, 25 (Suppl 1), 64-7

Gruntar I, Malovrh T, Murgia R, Cinco M (2001) Conversion of *Borrelia garinii* cystic forms to motile spirochetes in vivo *APMIS* 109(5) 383-388

Miklossy J, Kasas S, Zurn AD, McCall S, Yu S, McGeer PL. (2008) Persisting atypical and cystic forms of *Borrelia burgdorferi* and local inflammation in Lyme neuroborreliosis. *J Neuroinflammation*. 25, 5, 40, 1-18.

<http://www.jneuroinflammation.com/content/5/1/40> In Vivo

Barbour A (2012) Remains of infection. *J. Clin. Invest.* <http://www.jci.org/articles/view/63975> In Vivo

DeLAMATER ED, WIGGALL RH, HAANES M. (1950) Studies on the life cycle of spirochetes; the life cycle of the Nichols pathogenic *Treponema pallidum* in the rabbit testis as seen by phase contrast microscopy. *J Exp Med.* 92(3), 239-246. [[PMC free article](#)] [[PubMed](#)]

DeLamater ED, Wiggall RH, Haanes M (1950) STUDIES ON THE LIFE CYCLE OF SPIROCHETES IV. THE LIFE CYCLE OF THE NICHOLS PATHOGENIC TREPONEMA PALLIDUM IN THE RABBIT TESTIS AS VISUALIZED BY MEANS OF STAINED SMEARS. *J Exp Med.* 92(3), 247-252. PMID: PMC2136032

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2136032/>

DELAMATER ED, NEWCOMER VD, et al. (1950) Studies on the life cycles of spirochetes; the use of phase contrast microscopy. *Am J Syph Gonorrhoea Vener Dis.* 34(2), 122-125. [[PubMed](#)]

DELAMATER ED, HAANES M, WIGGALL RH, PILLSBURY DM (1951) STUDIES ON THE LIFE CYCLE OF SPIROCHETES. *THE JOURNAL OF INVESTIGATIVE DERMATOLOGY* 16, 231-56 <http://lymerick.net/1951-Delamater.htm>

Preac Mursic V, Weber K, Pfister HW, Wilske B et al. (1989) Formation and cultivation of *Borrelia burgdorferi* spheroplast L-Form variants. *Infection* 17, 355-359

Preac-Mursic V, Wanner G, Reinhardt S, Wilske B, Busch U, Marget W (1996) Formation and cultivation of *Borrelia burgdorferi* spheroplast L-form variants. *Infection* 24, 218-226.

<http://www.ncbi.nlm.nih.gov/pubmed/8852456>

Bruck DK, Talbot ML, Cluss RG, Boothby JT (1995) Ultrastructural characterization of the stages of spheroplast preparation of *Borrelia burgdorferi*. *J Microbiol Methods* 23, 219-228.

Brorson O, Brorson SH (1995) In Vitro Conversion of *Borrelia burgdorferi* to Cystic Forms in Spinal Fluid, and Transformation to Mobile Spirochetes by Incubation in BSK-H Medium. *Infection* 26(3) 144-150

Kersten A, Poitschek C, Rauch S, Aberer E. (1995) Effects of penicillin, ceftriaxone, and doxycycline on morphology of *Borrelia burgdorferi*. *Antimicrob Agents Chemother.* 39(5), 1127-33

<http://aac.asm.org/content/39/5/1127.full.pdf> <http://www.ncbi.nlm.nih.gov/pubmed/7625800>

„According to experiences from studies with other spirochetes it is suggested that encysted borreliae, granules, and the

remaining blebs might be responsible for the ongoing antigenic stimulus leading to complaints of chronic Lyme borreliosis.“

Brorson O, Brorson SH (1997) Transformation of cystic forms of *Borrelia burgdorferi* to normal mobile spirochetes. *Infection* 25(4) 240-246

Brorson O, Brorson SH (1998) In vitro conversion of *Borrelia burgdorferi* to cystic forms in spinal fluid, and transformation to mobile spirochetes by incubation in BSK-H medium. *Infection* 26(3) 144-150

Brorson O, Brorson SH (1999) A rapid method for generating cystic forms of *Borrelia burgdorferi*, and their reversal to mobile spirochetes. *APMIS* 106, 1131–41.

Domingue GJ, S, Woody H (1997). [Bacterial persistence and expression of disease](#). *Clin. Microbiol. Rev.* 10(2), 320-344.

Wainwright M (1997) Extreme Pleomorphism and the bacterial life cycle: A forgotten controversy. *Perspectives in Biology and Medicine* 40, 407-414

Gruntar I, Malovrh T, Murgia R, Cinco M (2001) Conversion of *Borrelia garinii* cystic forms to motile spirochetes in vivo *APMIS* 109(5) 383-388

Gruntar I, Malovrh T, Murgia R, Cinco M. (2003) Lyme Disease Studies on the Cystic Form of *Borrelia burgdorferi* Mechanisms of Persistence. <http://www.lymeinfo.net/medical/LDCysts.pdf>

Murgia R, Piazzetta C, Cinco M. (2002) Cystic forms of *Borrelia burgdorferi* sensu lato: induction, development, and the role of RpoS. *Wien. Klein. Wochenschr* 114(13-14) 574-579

Murgia R, Cinco M (2004) Induction of cystic forms by different stress conditions in *Borrelia burgdorferi*. *APMIS* 112(1), 57-62

Embers ME, Ramamoorthy R, Philipp MT. (2004) Survival strategies of *Borrelia burgdorferi*, the etiologic agent of Lyme disease. *Microbes Infect* 6,312–8.

MacDonald AB (2006) [A life cycle for Borrelia spirochetes?](#). *Medical Hypotheses*. 67(4), 810-818 <http://www.theoneclickgroup.co.uk/documents/Borreliosis/A%20life%20cycle%20for%20Borrelia%20spirochetes.htm>

MacDonald AB (2006) [Spirochetal cyst forms in neurodegenerative disorders...hiding in plain sight](#). *Med Hypotheses*. 67(4), 819-32. <http://www.ncbi.nlm.nih.gov/pubmed/16828236>

Miklossy J, Kasas S, Zurn AD, McCall S, Yu S, McGeer PL. (2008) Persisting atypical and cystic forms of *Borrelia burgdorferi* and local inflammation in Lyme neuroborreliosis. *J Neuroinflammation*. 25, 5, 40,1-18. <http://www.jneuroinflammation.com/content/5/1/40> In Vivo

Feng J, Wang T, Shi W, Zhang S, Sullivan D, Auwaerter PG, Zhang Y. (2014) Identification of novel activity against *Borrelia burgdorferi* persists using an FDA approved drug library. *Emerg Microbes Infect.* 3(7), e49

Caskey JR, Embers ME (2015) Persister Development by *B. burgdorferi* Populations In Vitro. [ASM Journals](#). DOI: <http://dx.doi.org/10.1128/aac.00883-15>

<https://www.growkudos.com/articles/10.1128/aac.00883-15>

Sharma B, Brown AV, Matluck NE, Hu LT, Lewis K (2015) *Borrelia burgdorferi*, the causative agent of Lyme disease, forms drug-tolerant persister cells. [Antimicrob Agents Chemother.](#) pii: AAC.00864-15. [Epub ahead of print] <http://www.ncbi.nlm.nih.gov/pubmed/26014929>

Kroun M (2007) Microscopy, Culture or PCR-verified cases of persistent [seronegative] Lyme Borreliosis. <http://lymerick.net/persistent-borreliosis.html>

Samiya Al-Robaiy S, Dihazi H, Kacza J et al. (2010) Metamorphosis of *Borrelia burgdorferi* organisms – RNA, lipid and protein composition in context with the spirochetes' shape. *Journal of Basic Microbiology* 2010, 50, 1–13

Barbour A. (2012) Remains of infection. *Journal of Clinical Investigation* 122(7), 2344-2346

<https://dl.dropboxusercontent.com/u/47501788/Remain%20of%20infection%202012%20Barbour%2CA%20G.pdf>  
<http://www.jci.org/articles/view/63975>

Lemgruber L, Brenner C, Kudryashev M (2012) Formation of 'dormant' *Borrelia* stages.

[http://www.emc2012.org.uk/documents/Abstracts/Abstracts/EMC2012\\_0697.pdf](http://www.emc2012.org.uk/documents/Abstracts/Abstracts/EMC2012_0697.pdf)

MacDonald A. (2013) Shape shifting Form Metamorphosis Non-Spiral *Borrelia* An Image Gallery

<https://www.dropbox.com/s/fq6afgipp9fvlS/July%2014%20PDF%20of%20shape%20shifted%20borelia%20lecture%20ABM.pdf>

Same document as video [http://www.youtube.com/watch?v=pqKaM\\_J7KDI](http://www.youtube.com/watch?v=pqKaM_J7KDI)

MacDonald A (2013) Round Forms of *Borrelia burgdorferi*. *Survival of the Microbe and Attack Models*.

<http://alzheimerborreliosis.net/wp-content/uploads/2012/10/April-12-2012-PDF-Cystic-Borrelia-Manifesto.pdf>

Lantos PM, Auwaerter PG, Wormser GP (2013) A Systematic Review of *Borrelia burgdorferi* Morphologic Variants Does Not Support a Role in Chronic Lyme Disease. *Clin Infect Dis*.

<http://cid.oxfordjournals.org/content/early/2013/12/12/cid.cit810.abstract>

“In the context of the broader medical literature it is not currently possible to ascribe a pathogenic role to morphologic variants of *B. burgdorferi* in either typical manifestations of Lyme disease or in other chronic disease states that are often labeled chronic Lyme disease. There is no clinical literature to justify specific treatment of *B. burgdorferi* morphologic variants”.

Kraiczi P (2011) Überleben im humanen Wirt: Wie sich Borrelien der Immunabwehr entziehen. *Der Mikrobiologe* 21(6), 186-192 <http://bibnet.org/vufind/Record/ccmed952197517>

- Kraiczky P (2013) Immunescape-Mechanismen von *Borrelia burgdorferi*, dem Erreger der Lyme Borreliose. <https://www.kgu.de/?id=1764>
- Barbour A. (2012) Remains of infection. *Journal of Clinical Investigation* 122(7), 2344-2346 <https://dl.dropboxusercontent.com/u/47501788/Remain%20of%20Infection%202012%20Barbour%2CA%20G.pdf>
- Berntson K (2013) Review of evidence for immune evasion and persistent infection in Lyme disease. *Int. J. of Gen. Med.*, 6, 291 - 306 <http://www.dovepress.com/review-of-evidence-for-immune-evasion-and-persistent-infection-in-lyme-peer-reviewed-article-IJGM>
- Huismans BD (2014) Abwehr- und Escape- Mechanismen der Borrelien gegen das menschliche Immunsystem und gegenüber Antibiotika und Chemotherapeutika. Warum Borrelien infektiös bleiben trotz intensiver antibiotischer Behandlung <http://www.xerlebnishaft.de/escape.pdf>
- Huismans BD (2014) Defense and escape mechanisms of *Borrelia* against the human immune system and against antibiotics and chemotherapeutics. Why *Borrelia* remains infectious despite intensive antibiotic treatment. [http://www.xerlebnishaft.de/escape\\_eng.pdf](http://www.xerlebnishaft.de/escape_eng.pdf)
- Berghoff W (2014) Abwehrmechanismen von *Borrelia burgdorferi* (Bb) gegenüber dem humanen Immunsystem. [http://www.praxis-berghoff.de/dokumente/berghoff150714/Kapitel\\_23-b\\_Abwehrmechanismen\\_von\\_Bb.pdf](http://www.praxis-berghoff.de/dokumente/berghoff150714/Kapitel_23-b_Abwehrmechanismen_von_Bb.pdf)
- Wallich R (2015) Immune escape mechanisms of *Borrelia* and vaccines against Lyme disease. Nationales Lyme-Borreliose-Symposium. NaBoS 2015 Erfurt, Freitag, 20. März 2015
- Hyde JA (2017) *Borrelia burgdorferi* Keeps Moving and Carries on: A Review of Borrelial Dissemination and Invasion. *Front. Immunol.*, <https://doi.org/10.3389/fimmu.2017.00114> <http://journal.frontiersin.org/article/10.3389/fimmu.2017.00114/full>
- Meriläinen L, Herranen A, Schwarzbach A, Gilbert L (2015) Morphological and biochemical features of *Borrelia burgdorferi* pleomorphic forms. *Microbiology*. pii: mic.0.000027. doi: 10.1099/mic.0.000027. <http://mic.sgmjournals.org/content/early/2015/01/05/mic.0.000027> <http://www.ncbi.nlm.nih.gov/pubmed/25564498>
- « However, the round bodies displayed lower metabolic activity compared to spirochetes. Furthermore, our results indicated that the different pleomorphic variants were distinguishable by having unique biochemical signatures. Consequently, pleomorphic *B. burgdorferi* should be taken into consideration as being clinically relevant and influence the development of novel diagnostics and treatment protocols. »
- Meriläinen L, Brander H, Herranen A, Schwarzbach A, Gilbert L (2016) Pleomorphic forms of *Borrelia burgdorferi* induce distinct immune responses. *Microbes and Infection*, doi: 10.1016/j.micinf.2016.04.002 <http://www.sciencedirect.com/science/article/pii/S1286457916300296> <http://www.ncbi.nlm.nih.gov/pubmed/27139815>
- « Here, we demonstrated that round bodies were processed differently in differentiated macrophages, consequently inducing distinct immune responses compared to spirochetes in vitro. Colocalization analysis indicated that the F-actin participates in internalization of both forms. However, round bodies end up less in macrophage lysosomes than spirochetes suggesting that there are differences in processing of these forms in phagocytic cells. Furthermore, round bodies stimulated distinct cytokine and chemokine production in these cells. We confirmed that spirochetes and round bodies present different protein profiles and antigenicity. In a Western blot analysis Lyme disease patients had more intense responses to round bodies when compared to spirochetes. These results suggest that round bodies have a role in Lyme disease pathogenesis. »
- Sharma B, Brown AV, Matluck NE, Hu LT, Lewis K (2015) *Borrelia burgdorferi*, the causative agent of Lyme disease, forms drug-tolerant persister cells. *Antimicrob Agents Chemother*. pii: AAC.00864-15. <http://www.ncbi.nlm.nih.gov/pubmed/26014929#>
- „After addition of ceftriaxone, the antibiotic was washed away, surviving persisters were allowed to resuscitate, and antibiotic was added again. Four pulse-doses of ceftriaxone killed persisters, eradicating all live bacteria in the culture“.
- Feng J, Shi W, Zhang Sh, Zhang Y (2015) Persister mechanisms in *Borrelia burgdorferi*: implications for improved intervention. *Emerg Microbes Infect*. 4(8), e51. Published online 2015 Aug 19. doi: [10.1038/emi.2015.51](https://doi.org/10.1038/emi.2015.51) PMID: PMC4576169 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576169/>
- Brucellas**
- Hatten BA, Sulkin SE. (1966) Intracellular production of *Brucella* L forms. I. Recovery of L forms from tissue culture cells infected with *Brucella abortus*. *J. Bakteriol.* 91, 285-296.
- Mycoplasma**
- Razin S, Yogev D, Naot Y (1998) [Molecular Biology and Pathogenicity of Mycoplasmas](#). *Microbiol. Mol. Biol. Rev.* 62(4), 1094–156. [PMC 98941](#). [PMID 9841667](#).
- Staphylococcus aureus**
- Trofimova ND (1959) Studies of the conditions for regeneration of filterable forms of staphylococci. *Microbiol. J. Acad. Sci. Ukrain* 21, 45
- Fuller E, Elmer C, Nattress F, et al (2005). [β-Lactam Resistance in Staphylococcus aureus Cells That Do Not Require a Cell Wall for Integrity](#). *Antimicrob. Agents Chemother.* 49 (12), 5075–80. [doi:10.1128/AAC.49.12.5075-5080.2005](#). [PMC 1315936](#). [PMID 16304175](#).

## **Streptococci**

Cook J, et al. (1969) Chronic arthritis produced by streptococcal L-forms. *J Pathol.* 99 (4), 283-297.  
Green MT, Heidiger Jr. PM, Domingue GJ (1974) Proposed reproductive cycle for a relatively stable L-Phase Variant of *Streptococcus faecalis*. *Infect Immun* 10, 915-927  
[Rollin G, Tan X, Tros F et al. \(2017\) Intracellular Survival of Staphylococcus aureus in Endothelial Cells: A Matter of Growth or Persistence. \*Front Microbiol.\* 8, 1354. Published online 2017 Jul 19. doi: 10.3389/fmicb.2017.01354 PMID: 28769913 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5515828/>](#)

## **Nocardia**

Beaman BL (1980). [Induction of L-phase variants of \*Nocardia caviae\* within intact murine lungs](#). *Infect. Immun.* 29 (1), 244–51. [PMC 551102](#). [PMID 7399704](#).  
Beaman BL, Scates SM (1981). [Role of L-forms of \*Nocardia caviae\* in the development of chronic mycetomas in normal and immunodeficient murine models](#). *Infect. Immun.* 33 (3), 893–907. [PMC 350795](#). [PMID 7287189](#).

## **Escheria coli**

Joseleau-Petit D, Liébart JC, Ayala JA, D'Ari R (2007). [Unstable \*Escherichia coli\* L Forms Revisited: Growth Requires Peptidoglycan Synthesis](#). *J. Bacteriol.* 189 (18), 6512–20. [doi:10.1128/JB.00273-07](#). [PMC 2045188](#). [PMID 17586646](#).

## **Salmonelles**

Nix RN, Altschuler SE, Henson PM, Detweiler CS (2007) Hemophagocytic macrophages harbor *Salmonella enterica* during persistent infection. *PLoS Pathog.* 3, e193  
Claudi B, Spröte P, Chirkova A et al. (2014) Phenotypic Variation of *Salmonella* in Host Tissues Delays Eradication by Antimicrobial Chemotherapy. *158(4)*, 722–733  
DOI: <http://dx.doi.org/10.1016/j.cell.2014.06.045>  
<http://www.cell.com/cell/abstract/S0092-8674%2814%2900872-1>  
Helaine, S et al. (2014) Internalization of *Salmonella* by macrophages induces formation of nonreplicating persisters. *Science* 343, 204–208.

## **Listeria**

Brem AM, Eveland WC. Inducing L-forms in *Listeria monocytogenes* type 1 through 7. *Appl. Microbiol.* 15, 1510.  
Brem AM (1968) The role of L-Forms in the pathogenesis of *Listeria monocytogenes* infections. Ph. D Dissertation, University of Michigan, Ann Arbor.  
Prosorowsky S, Kotljarova J, Fedotova I et al. (1976) Pathogenicity of Listerial L-Forms in Spheroplasts, Protoplasts and L-Forms of Bacteria. *INSERM.* 65, 265-272  
Beson CA, Baugh CL. (1983) Cell wall deficient forms of *Listeria monocytogenes* as a natural phenomenon. *Abst. Ann. Meet ASM*  
Dell'Éra S, Buchrieser C, Couvé E et al (2009) *Listeria monocytogenes* L-Forms Respond to Cell Wall Deficiency by Modifying Gene Expression and the Mode of Division. *Mol Microbiol.* 73, 306-322

## **Bacillus subtilis**

Gilpin RW, Young FE, Chatterjee AN (1973) [Characterization of a Stable L-Form of \*Bacillus subtilis\* 168](#). *J. Bacteriol.* 113 (1), 486–99. [PMC 251652](#). [PMID 4631836](#).  
Allan EJ (1991) Induction and cultivation of a stable L-form of *Bacillus subtilis*. *J. Appl. Bacteriol.* 70 (4), 339–43. [doi:10.1111/j.1365-2672.1991.tb02946.x](#). [PMID 1905284](#).  
Leaver M, Domínguez-Cuevas P, Coxhead JM, Daniel RA, Errington J (2009) [Life without a wall or division machine in \*Bacillus subtilis\*](#). *Nature* 457 (7231), 849–53. [doi:10.1038/nature07742](#). [PMID 19212404](#)

## **Proteus mirabilis**

Rippmann JF, Klein M, Hoischen C, et al (1998) [Prokaryotic Expression of Single-Chain Variable-Fragment \(scFv\) Antibodies: Secretion in L-Form Cells of \*Proteus mirabilis\* Leads to Active Product and Overcomes the Limitations of Periplasmic Expression in \*Escherichia coli\*](#). *Appl. Environ. Microbiol.* 64 (12), 4862–9. [PMC 90935](#). [PMID 9835575](#)

## **Fungi**

Tunstall LH, Mattman LH. (1961) L variation in *Candida* species. *Bacteriol. Proc.* 1961, 83  
Rosner R. (1966) Isolation of *Candida* protoplasts from a case of *Candida* endocarditis. *J. Bacteriol.* 91, 1320-1326  
Swieczkowski DM, Mattman LH, Truant JP et al. (1970) Cell wall deficient forms of *Candida albicans* in mycohemias. *Lab. Med.* 1, 41-42.

## **Chlostridium botulinum**

Brown GW, King G, Sugiyama H (1970) Penicilline-lysocyme conversion of *Chlostridium botulinum* Types A and E into protoplasts and their stabilization as L form cultures. *J. Bacteriol.* 104, 1325-1331  
<http://www.ncbi.nlm.nih.gov/pubmed/16559111>  
s.a. <http://www.bfr.bund.de/cm/343/chronischer-botulismus-aktueller-stand-der-wissenschaft.pdf>



## Bacterioplankton

Yawata Y, Cordero OX, Menolascina F et al. (2014) Competition–dispersal tradeoff ecologically differentiates recently speciated marine bacterioplankton populations. *PNAS*, 111, 5622-27.  
<http://www.pnas.org/content/early/2014/04/01/1318943111>

## Spermin, Spermidine

Tabor WC (1962) Stabilization of protoplasts and spheroplasts by spermine and other polyamides. *J. Bacteriol.* 83 1101-1111

Lida Mattman (1964) Cell Wall Deficient Forms. *Stealth Pathogens*. CRC Press 2001 Seite 93

Harold FM. (1964) Stabilization of *Streptococcus faecalis* protoplasts by spermine. 88, 1416-1420

Polyamines: Mysterious Functions *Nature News and Views* (1970) *Nature* 226, 317-318

Hirschman S, Leng M, Felsenfield G. (1967) Interaction of spermine and DNA. *Biopolymers*. 5(2), 227–233.  
[PubMed]

Lapinski EM, Flakas ED. (1970) Reversal of penicillin-induced L-phase growth of *Haemophilus influenzae* by spermine and its effects on antibiotic susceptibility. *Infect. Immun.* 1 474-478

Raina A, Jänne J. (1975) Physiology of the natural polyamines putrescine, spermidine and spermine. *Med Biol.* 53(3) 121-47. <http://www.ncbi.nlm.nih.gov/pubmed/169440>

«Polyamines are able to stimulate protein and ribonucleic acid synthesis in vitro. In several systems characterized by rapid growth polyamines and ribonucleic acid accumulate in parallel. Evidence that polyamines may have an essential role in protein and/or nucleic acid synthesis is substantiated by recent observations on polyamine-deficient bacterial mutants, although no specific function has been established with certainty as yet. Some clinical applications of polyamine research related to cancer are also discussed briefly.»

Eisenberg T, Knauer H (2009) Induction of autophagy by spermidine promotes longevity. *Nature Cell Biology* 11, 1305 - 1314 <http://www.nature.com/ncb/journal/v11/n11/abs/ncb1975.html>

Kaeberlein M (2009) Spermidine surprise for a long life. *Nature Cell Biology* 11, 1277 - 1278  
<http://www.nature.com/ncb/journal/v11/n11/abs/ncb1109-1277.html>

Büttner S, Eisenberg T, Kroemer G et al. (2010) Spermidine: a novel autophagy inducer and longevity elixir. *Autophagy*. 6, 1.

Morselli E, Galluzzi L, Kepp O et al. (2010) Autophagy mediates pharmacological lifespan extension by spermidine and resveratrol. *Aging* 2010-2-17 PMID 20157579

<https://www.sigmaaldrich.com/catalog/papers/20157579>

“Although autophagy has widely been conceived as a self-destructive mechanism that causes cell death, accumulating evidence suggests that autophagy usually mediates cytoprotection, thereby avoiding the apoptotic or necrotic demise of stressed cells. Recent evidence produced by our groups demonstrates that autophagy is also involved in pharmacological manipulations that increase longevity. Exogenous supply of the polyamine spermidine can prolong the lifespan of (while inducing autophagy in) yeast, nematodes and flies. Similarly, resveratrol can trigger autophagy in cells from different organisms, extend lifespan in nematodes, and ameliorate the fitness of human cells undergoing metabolic stress. These beneficial effects are lost when essential autophagy modulators are genetically or pharmacologically inactivated, indicating that autophagy is required for the cytoprotective and/or anti-aging effects of spermidine and resveratrol. Genetic and functional studies indicate that spermidine inhibits histone acetylases, while resveratrol activates the histone deacetylase Sirtuin 1 to confer cytoprotection/longevity. Although it remains elusive whether the same histones (or perhaps other nuclear or cytoplasmic proteins) act as the downstream targets of spermidine and resveratrol, these results point to an essential role of protein hypoacetylation in autophagy control and in the regulation of longevity.»

Sigrist SJ, Carmona-Gutierrez D, Gupta VK et al. (2014) Spermidine-triggered autophagy ameliorates memory during aging. *Autophagy*, 10,1, 178-179, DOI: 10.4161/auto.26918

<http://dx.doi.org/10.4161/auto.26918> <http://www.ncbi.nlm.nih.gov/pubmed/24262970>

Gupta VK, Pech U, Bhukel A (2016) Spermidine Suppresses Age-Associated Memory Impairment by Preventing Adverse Increase of Presynaptic Active Zone Size and Release. *PLOS Biology*

<http://dx.doi.org/10.1371/journal.pbio.1002563>

<http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1002563>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## Integration

Wolbach SB (1919) Studies on Rocky Mountain Spotted Fever. *J Med Res* 41, 1-197

<https://archive.org/details/studiesonrockymo00wolb> [“Intranuclear forms”, S. 80, 83-86, 106-115]

Ma, Y., Sturrock A, Weis J (1991) Intracellular localization of *Borrelia burgdorferi* within human endothelial cells. *Infect Immun*, 59(2), 671-8

Haupl TH, Krause A, Bittig M. (1992) Persistence of *Borrelia burgdorferi* in chronic Lyme Disease: altered immune regulation or evasion into immunologically privileged sites? Abstract 149 Fifth International

Conference on Lyme Borreliosis, Arlington, VA

Klempner MS, Noring R, Rogers RA (1993) Invasion of human skin fibroblasts by the Lyme disease spirochete, *Borrelia burgdorferi*. *J Infect Dis.* 167(5), 1074- 81

Hulinska D, Basta J, Murgia R, Cinco M (1995) Intracellular morphological events observed by electron microscopy on neutrophil phagocytosis of *Borrelia garinii* *Journal of Spirochetal and Tick-Borne Diseases.* 2(4), 82-86.

Girschick HJ, Huppertz HI, Russmann H, Krenn V, Karch H. (1996) Intracellular persistence of *Borrelia burgdorferi* in human synovial cells. *Rheumatol Int* 16(3), 125–132

Dorward, D.W., E.R. Fischer, D.M. Brooks, (1997) Invasion and cytopathic killing of human lymphocytes by spirochetes causing Lyme disease. *Clin Infect Dis*, 25 Suppl 1, S2-8

Chary-Valckenaere I, Jaulhac B, Champigneulle J, Piement Y, Mainard D, Pourel J (1998) Ultrastructural demonstration of intracellular localization of *Borrelia burgdorferi* in Lyme arthritis. *Br J Rheumatol* 37, 468-470.

Livengood, J.A. and R.D. Gilmore, Jr., (2006) Invasion of human neuronal and glial cells by an infectious strain of *Borrelia burgdorferi*. *Microbes Infect*, 8(14-15), 2832-40

### **Immunmanipulation**

Liang FT, Yan J, Mbow ML et al. (2004). "[Borrelia burgdorferi changes its surface antigenic expression in response to host immune responses](#)". *Infect Immun* 72 (10), 5759–5767.

Hurdle JG, O'Neill AJ, Chopra I, Lee RE (2011) Targeting bacterial membrane function: an underexploited mechanism for treating persistent infections. *Nature Reviews Microbiology* 9, 62–75 doi:10.1038/nrmicro2474 <http://www.nature.com/nrmicro/journal/v9/n1/glossary/nrmicro2474.html>

Schutzer SE, Coyle PK, Belman AL et al. (1990) Sequestration of antibody to *Borrelia burgdorferi* in immune complexes in sero-negative Lyme disease. *Lancet* 335(8685), 312-315

### **Membrane ATPases, Effluxmechanisms**

Webber MA, Piddock LJV (2003) The importance of efflux pumps in bacterial antibiotic resistance. *J. Antimicrob. Chemother.* 51(1), 9-11.

Gibbons S1, Oluwatuyi M, Kaatz GW (2003) A novel inhibitor of multidrug efflux pumps in *Staphylococcus aureus*. *J Antimicrob Chemother.* 51(1), 13-7. <http://www.ncbi.nlm.nih.gov/pubmed/12493782>

« GG918, a synthetic inhibitor of P-glycoprotein-mediated mammalian tumour multidrug resistance, was found to be equipotent to reserpine in enhancing the in vitro activity of norfloxacin and ciprofloxacin against strains of *Staphylococcus aureus* expressing distinct efflux-related multidrug resistance pumps. ... Using GG918 as a lead compound, a structure-activity evaluation may reveal a more potent and broader spectrum inhibitor of *S. aureus* antibiotic efflux pumps. »

Mahamoud A, Chevalier J, Alibert-Franco S (2007) Antibiotic efflux pumps in Gram-negative bacteria: the inhibitor response strategy. *J. Antimicrob. Chemother.* 59(6), 1223-1229.

Amaral L, Fanning, Pagès JM (2011) Efflux pumps of Gram-negative bacteria: Genetic responses to stress and the modulation of their activity by pH, inhibitors and phenothiazines. *Advances in Enzymology* 77, 61-108. PMID

Adams KN et al. (2011) Drug tolerance in replicating mycobacteria mediated by a macrophage-induced efflux mechanism. *Cell* 145, 39–53 [[PubMed](#)] (Efflux pump inhibitors: verapamil or reserpine).

Amaral L, Spengler G, Martins A, Molnar J (2013) Efflux pumps that bestow multi-drug resistance of pathogenic Gram-negative bacteria. *Biochem Pharmacol Open Access* 2, 3. August. DOI

Amaral L, Martins A, Spengler G, Molnar J (2014) Efflux pumps of Gram-negative bacteria: what they do, how they do it, with what and how to deal with them. *Frontiers In Pharmacology Open Access* Jan. DOI

Yu EW, Zhang Q, Brown MH (2013) *Microbial Efflux Pumps: Current Research*. Caister Academic Press. <http://www.horizonpress.com/efflux-pumps>

Kristiansen JE, J Molnar, Amaral, S Dastidar (2013) Role of Phenothiazines and Structurally Similar Compounds of Plant Origin in the Fight against Infections by Drug Resistant Bacteria, Efflux Pumps of Multi-Drug Resistant Pathogenic Bacteria: Their Genetic Regulation, Molecular Biology and Possible Control with Newly Designed Agents. *Biochemistry & Pharmacology Open Access Journal* 2, 58. 1.

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.6 Biofilms and Quorum sensing**

Costerton JW, Lewandowski Z, DeBeer D et al. (1994) Biofilms, the customized microniche. *Journal of Bacteriology* 176, 2137-2142.

Costerton JW (1995) Overview of microbial biofilms. *J Ind Microbiol* 15: 137-140

Costerton JW, Lewandowski Z, Caldwell EC. et al. (1995). *Microbial biofilms*. Annual Review of Microbiology



49, 711-745.

Costerton, JW (1999) Introduction to biofilm. *Int J Antimicrob Agents* 11: 217-221

Costerton JW, Stewart PS et al. (1999) Bacterial biofilms: a common cause of persistent infections. In: *Science*. Bd. 284, Nr. 5418, [ISSN 0036-8075](#), [PMID 10334980](#), 1318-1322

Costerton, JW. (2001). Cystic fibrosis pathogenesis and the role of biofilms in persistent infection. *Trends Microbiol* 9: 50-52

Costerton, JW (2007) *The biofilm primer*. Berlin, Springer-Verlag. 199 pp.

Marsh PD, Bradshaw DJ. (1995) Dental plaque as a biofilm. *J Ind Microbiol*. 15(3), 169–75. [PubMed](#)

Davey ME, O'Toole GA (2000) Microbial biofilms: from ecology to molecular genetics. *Microbiol Mol Biol Rev*. 64,847–867.

Brown SP, Johnstone RA (2001) Cooperation in the dark: signalling and collective action in quorum-sensing bacteria. *Proc Biol Sci* 268: 961–965. [Find this article online](#)

Lewis, K. (2001) [Riddle of biofilm resistance](#). *Antimicrob. Agents & Chemoth.* 45(4), 999-1007

Kaiser D (2001) Building a multicellular organism. [Annu Rev Genet](#), 35, 103-23

Stoodley P, Sauer K, Davies DG, Costerton JW. (2002) Biofilms as complex differentiated communities. *Annu Rev Microbiol*. 56, 187–209.

Stewart PS (2002) Mechanisms of antibiotic resistance in bacterial biofilms. *Int J Med Microbiol* 292, 107–113.

Donlan RM, Costerton JW (2002) Biofilms Survival Mechanisms of Clinically Relevant Microorganisms. *Clin. Microbiol. Rev.* 15, 167–193.

Parsek MR, Singh PK (2003) [Bacterial biofilms: an emerging link to disease pathogenesis](#). *Annual review of microbiology*, 57, 677-701

Webb JS et al. (2003) Bacterial biofilms: prokaryotic adventures in multicellularity. [Curr Opin Microbiol](#), 6, 578-85

Hammer BK, Bassler BL (2003). Quorum sensing controls biofilm formation in *Vibrio cholerae*. *Mol Microbiol*, 50, 101-4.

Stevenson B, von Lackum K, Wattier RL et al., (2003) Quorum sensing by the Lyme disease spirochete. *Microbes Infect* 5, 991–7.

Szewzyk U, Szewzyk R. (2003) Biofilme – die etwas andere Lebensweise. In: *BIOspektrum*. 9, 253–255 ([PDF-Datei; 0,3 MB](#))

Sauer K (2003) The genomics and proteomics of biofilm formation. *Genome Biol* 4, 219.

Hall-Stoodley L, Costerton JW, & Stoodley P (2004) [Bacterial biofilms: from the Natural environment to infectious diseases](#). *Nat Rev Micro*, 2(2), 95-108

<http://www.nature.com/nrmicro/journal/v2/n2/abs/nrmicro821.html>

Cogan NG, Cortez R, Fauci L (2005) [Modeling physiological resistance in bacterial biofilms](#). *Bulletin of mathemati.biology*, 67(4), 831-53

Ristow P, Bourhy P, Kerneis S et al. (2008) Biofilm formation by saprophytic and pathogenic leptospires. *Microbiology* 154, 1309-1317.

Kerksiek K (2008) *Leben im Schleim: Biofilme beherrschen die Welt*.

[http://www.infection-research.de/de/perspectives/detail/pressrelease/a\\_life\\_in\\_slime\\_biofilms\\_rule\\_the\\_world-2/](http://www.infection-research.de/de/perspectives/detail/pressrelease/a_life_in_slime_biofilms_rule_the_world-2/)

Eisendle M et al (2008) Biofilms of *Borrelia burgdorferi* in chronic cutaneous borreliosis, *Am J Clin Pathol*, 129, 988-989.

Nadell CD et al. (2009) The sociobiology of biofilms. [Fems Microbiol Rev](#). 33, 206-24

Ito A, Taniuchi A, May T, Kawata, K. & Okabe S (2009) Increased antibiotic resistance of *Escherichia coli* in mature biofilms. *Appl. Environ. Microbiol*. 75, 4093–4100

Rumbaugh KP, Diggle SP, Watters CM, Ross-Gillespie A, Griffin AS, et al. (2009) Quorum sensing and the social evolution of bacterial virulence. *Curr Biol* 19: 341–345. [Article online](#)

Uroz S, Dessaux Y, Oger P. (2009) [Quorum sensing and quorum quenching: the yin and yang of bacterial communication](#). *Chembiochem A European Journal Of Chemical Biology*

Luecke DF et al. (2009) Novel Fugitive Strategy for *Borrelia burgdorferi*: Biofilm

<http://www.lymeneteurope.org/forum/viewtopic.php?f=5&t=2776>

Anderson GG, Goller CC, Justice S (2010) Polysaccharide Capsule and Sialic Acid-Mediated Regulation Promote Biofilm-Like Intracellular Bacterial Communities during Cystitis [@](#)

*Infect. Immun.* 78(3), 963-975 <http://iai.asm.org/content/78/3/963.full>

<http://iai.asm.org/content/78/3/963/F6.large.jpg>

Mehvish S, Betty Daniel (2011) Role of Biofilms in the progression of Urinary tract Infections in patients with Diabetes Mellitus. *Int. J. Emerg. Sci.*, 1(2), 133-142, ISSN: 2222-4254

Choisy C (2011) Biofilms and public health. *Bull Acad Natl Med* 195(4-5), 1105-18; discussion 1118-20. [Abstract](#)

Nealson KH, Finkel SE (2011) Electron flow and biofilms. [MRS Bulletin](#), 36, 380-84

MacDonald AB. (2012) Structural Analysis of Biofilms of *Borrelia burgdorferi*. <https://dl.dropbox.com/u/47501788/Biofilms%20of%20Borrelia%20Teaching%20Article%20%28%29.pdf>

Sapi E, Bastian SL, Mpoy CM et al. (2012) Characterization of Biofilm Formation by *Borrelia burgdorferi* in Vitro. PLOS ONE 7(10), e48277 <http://xa.yimg.com/kq/groups/20271879/11...ofilms.pdf>  
<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0048277>

Alavi MR, Stojadinovic A, Izadjoo MJ (2012) An overview of biofilm and its detection in clinical samples. J Wound Care 21(8), 376-83. [Abstract](#)

Zoubos AB, Galanakos SP, Soucacos PN (2012) Orthopedics and biofilm--what do we know? A review. Med Sci Monit 18(6), RA89-96. [Abstract](#)

Bjarnsholt T, Høiby N, Donelli G et al. (2012) Understanding biofilms--are we there yet? FEMS Immunol Med Microbiol 65(2), 125-6. [Full Citation](#)

[Bjarnsholt T \(2013\) The role of bacterial biofilms in chronic infections. APMIS. Supplementum. <http://www.nextbio.com/b/search/article.nb?id=23635385>  
<https://onlinelibrary.wiley.com/doi/full/10.1111/apm.12099>](#)

„Acute infections caused by pathogenic bacteria have been studied extensively for well over 100 years. These infections killed millions of people in previous centuries, but they have been combated effectively by the development of modern vaccines, antibiotics and infection control measures. Most research into bacterial pathogenesis has focused on acute infections, but these diseases have now been supplemented by a new category of chronic infections caused by bacteria growing in slime-enclosed aggregates known as biofilms. Biofilm infections, such as pneumonia in cystic fibrosis patients, chronic wounds, chronic otitis media and implant- and catheter-associated infections, affect millions of people in the developed world each year and many deaths occur as a consequence. In general, bacteria have two life forms during growth and proliferation. In one form, the bacteria exist as single, independent cells (planktonic) whereas in the other form, bacteria are organized into sessile aggregates. The latter form is commonly referred to as the biofilm growth phenotype. Acute infections are assumed to involve planktonic bacteria, which are generally treatable with antibiotics, although successful treatment depends on accurate and fast diagnosis. However, in cases where the bacteria succeed in forming a biofilm within the human host, the infection often turns out to be untreatable and will develop into a chronic state. The important hallmarks of chronic biofilm-based infections are extreme resistance to antibiotics and many other conventional antimicrobial agents, and an extreme capacity for evading the host defences. In this thesis, I will assemble the current knowledge on biofilms with an emphasis on chronic infections, guidelines for diagnosis and treatment of these infections, before relating this to my previous research into the area of biofilms. I will present evidence to support a view that the biofilm lifestyle dominates chronic bacterial infections, where bacterial aggregation is the default mode, and that subsequent biofilm development progresses by adaptation to nutritional and environmental conditions. I will make a series of correlations to highlight the most important aspects of biofilms from my perspective, and to determine what can be deduced from the past decades of biofilm research. ... © 2013 APMIS Published by Blackwell Publishing Ltd.“

Maianskiĭ AN, Chebotar' IV, Evteeva NI, et al. (2012) Interspecies interaction of bacteria and the formation of mixed (polymicrobial) biofilm. Zh Mikrobiol Epidemiol Immunobiol (1), 93-101. [Abstract](#)

Wolcott R, Costeron JW, Raoult D, Cutler SJ (2012) The polymicrobial nature of biofilm infection. Clinical Microbiology and Infection. 19, 2. <http://www.ncbi.nlm.nih.gov/pubmed/22925473>

Wood TK (2012) Engineering Biofilms  
[http://www.rps.psu.edu/indepth/understanding\\_how\\_bacteria\\_function\\_in\\_communities\\_could\\_lead\\_to\\_a\\_host\\_of\\_new\\_applications.html?utm\\_source=Penn+State+Research+%26+Discovery&utm\\_campaign=68b44eed78-Research\\_and\\_Discovery\\_November\\_29\\_2012&utm\\_medium=email](http://www.rps.psu.edu/indepth/understanding_how_bacteria_function_in_communities_could_lead_to_a_host_of_new_applications.html?utm_source=Penn+State+Research+%26+Discovery&utm_campaign=68b44eed78-Research_and_Discovery_November_29_2012&utm_medium=email)

Lanter BB, Sauer K, Davies DG. (2014) Bacteria present in carotid arterial plaques are found as biofilm deposits which may contribute to enhanced risk of plaque rupture. mBio 5(3), e01206-14.  
doi:10.1128/mBio.01206-14. <http://mbio.asm.org/content/5/3/e01206-14>

[Wu S, Li X, Gunawardana M, Maguire K, Guerrero-Given D, Schaudinn C, Wang C, Baum MM, Webster P.](#)  
(2014) Beta- Lactam Antibiotics Stimulate Biofilm Formation in Non-Typeable *Haemophilus influenzae* by Up-Regulating Carbohydrate Metabolism. [PLoS One](#). 9(7), e99204. doi: 10.1371/journal.pone.0099204.  
eCollection 2014. <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0099204>  
<http://www.ncbi.nlm.nih.gov/pubmed/25007395>

„Our results suggest that beta-lactam antibiotic exposure may act as a signaling molecule that promotes transformation into the biofilm phenotype. Loss of viable bacteria, increase in biofilm biomass and decreased protein production coupled with a concomitant up-regulation of genes involved with glycogen production might result in a biofilm of sessile, metabolically inactive bacteria sustained by stored glycogen. These biofilms may protect surviving bacteria from subsequent antibiotic challenges, and act as a reservoir of viable bacteria once antibiotic exposure has ended.“

Schaller J (2014) COMBATING BIOFILMS.  
<http://www.lymebook.com/combating-biofilms-james-schaller> <http://lymebook.com/blog/news/combating-biofilm-book-james-schaller/>

Timmaraju A, Theophilus PAS, Balasubramanian K et al. (2015) Biofilm formation by *Borrelia sensu lato*. OXFORD Journals University Press. DOI: <http://dx.doi.org/10.1093/femsle/fnv120>  
<http://femsle.oxfordjournals.org/content/early/2015/07/23/femsle.fnv120>

Feng J, Weitner M, Shi W et al. (2016) Eradication of Biofilm-Like Microcolony Structures of *Borrelia burgdorferi* by Daunomycin and Daptomycin but not Mitomycin C in Combination with Doxycycline and

Cefuroxime. *Front. Microbiol.* <http://dx.doi.org/10.3389/fmicb.2016.00062>  
<http://journal.frontiersin.org/article/10.3389/fmicb.2016.00062/full>  
Muakkassa FK, Ghannoum M (2016) Updates on Therapeutic Strategies Against Candida (and Aspergillus) Biofilm Related Infections. *Adv Exp Med Biol.* 2016;931:95-103. doi: 10.1007/5584\_2016\_11.  
<https://www.ncbi.nlm.nih.gov/pubmed/27287466>  
Azeredo J, Azevedo NF, Briandet R et al. [show all](#) (2016) Critical review on biofilm methods. Pages 313-351  
Download citation <https://doi.org/10.1080/1040841X.2016.1208146>  
<https://www.tandfonline.com/doi/full/10.1080/1040841X.2016.1208146>  
Allen HB, Allawh R, Touati A et al. (2017) Alzheimer's Disease: The Novel Finding of Intracellular Biofilms. *J Neuroinfect Dis* 8, 247. doi:10.4172/2314-7326.1000247  
[https://www.researchgate.net/publication/317259538\\_Alzheimer's\\_Disease\\_The\\_Novel\\_Finding\\_of\\_Intracellular\\_Biofilms](https://www.researchgate.net/publication/317259538_Alzheimer's_Disease_The_Novel_Finding_of_Intracellular_Biofilms)  
Sapi E, Gupta K, Wawrzyniak K et al. (2019). Borrelia and Chlamydia can form mixed biofilms in infected human skin tissues. *European Journal of Microbiology and Immunology.* 1-10. 10.1556/1886.2019.00003.  
[https://www.researchgate.net/publication/332361852\\_Borrelia\\_and\\_Chlamydia\\_can\\_form\\_mixed\\_biofilms\\_in\\_infected\\_human\\_skin\\_tissues](https://www.researchgate.net/publication/332361852_Borrelia_and_Chlamydia_can_form_mixed_biofilms_in_infected_human_skin_tissues)

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.7 Anti – biofilm – medication**

Gilbert, P., Collier, P J., Brown, M. R. (1990) Influence of growth rate on susceptibility to antimicrobial agents: biofilms, cell cycle, dormancy, and stringent response. *Antimicrob. Agents Chemother.* 34, 1865–1868  
Olson ME, Ceri H, Morck DW, Buret AG, Read RR (2002) Biofilm bacteria: formation and comparative susceptibility to antibiotics. *Can. J. Vet. Res.* 66, 86–92.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC226988/>  
Hentzer M, Givskov M (2003) Pharmacological inhibition of quorum sensing for the treatment of chronic bacterial infections. *The J Clin Investigation* 112, 1300-1307  
Costerton W, Veeh R, Shirtliff M, Pasmore M, Post C, Ehrlich G. (2003) The application of biofilm science to the study and control of chronic bacterial infections. *J. Clin. Invest.* 112: 1466–1477.  
Rasmussen TB, Bjarnsholt T, Skindersoe ME et al. (2005) Screening for Quorum-Sensing Inhibitors (QSI) by Use of a Novel Genetic System, the QSI Selector. *J Bacteriol.* Mar 187(5), 1799–1814. doi: 10.1128/JB.187.5.1799-1814.2005 PMCID: PMC1063990  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1063990/>  
Ge T, Sun Z, Fu S, Liang G (2005). Cloning of thrombolytic enzyme (lumbrokinase) from earthworm and its expression in the yeast. *Protein Expression and Purification* 42 (1), 20. doi:10.1016/j.pep.2005.04.005  
Pace JL, Rupp ME, Finch RG. (2006) *Biofilms, Infection and Antimicrobial Therapy.* CRC Press.  
<https://academic.oup.com/cid/article/43/12/1623/279254>  
Alkawash MA, Soothill JS, Schiller NL. (2006) Alginate lyase enhances antibiotic killing of mucoid *Pseudomonas aeruginosa* in biofilms. *APMIS.* 114(2), 131-8.  
Musk DJ Jr., Hergenrother PJ (2006) Chemical Countermeasures for the Control of Bacterial Biofilms: Effective Compounds and Promising Targets. *Current Medicinal Chemistry*, 2006, 13, 2163-2177  
[http://www.scs.illinois.edu/~phgroup/pdfs/ref37\\_CurrMedChem\\_Musk\\_PDFReprint.pdf](http://www.scs.illinois.edu/~phgroup/pdfs/ref37_CurrMedChem_Musk_PDFReprint.pdf)  
Rasmussen TB, Givskov M. (2006) Quorum-sensing inhibitors as anti-pathogenic drugs. *Int J Med Microbiol.* 6(2-3), 149-61. <http://www.ncbi.nlm.nih.gov/pubmed/16503194>  
Bayles KW. (2007) Opinion: The biological role of death and lysis in biofilm development. *Nature Reviews Microbiology* 5, 721-726 doi:10.1038/nrmicro1743  
Bjarnsholt T, Givskov M (2007) Quorum-sensing blockade as a strategy for enhancing host defences against bacterial pathogens. *Philos Trans R Soc Lond B Biol Sci* 362, 1213–1222.  
Trautner BW, Hull RA et al. (2007) Coating urinary catheters with an avirulent strain of *Escherichia coli* as a means to establish asymptomatic colonization. In: *Infection control and hospital epidemiology.* Bd. 28, Nr. 1, ISSN 0899-823X, PMID 17230395, doi:10.1086/510872, S. 92–94  
Girenavar B, Cepeda ML, Soni KA et al. (2008) Grapefruit juice and its furocoumarins inhibits autoinducer signaling and biofilm formation in bacteria. *Int J Food Microbiol.* 125(2), 204-8. Epub  
Bjarnsholt T, Givskov M, (2008) Quorum Sensing Inhibitory Drugs as Next Generation Antimicrobials: Worth the Effort? *Current Medicine Group LLC* 10, 22–28  
[http://siba.unipv.it/fisica/articoli/C/CurrentInfectiousDiseaseReports2008\\_10\\_1\\_22.pdf](http://siba.unipv.it/fisica/articoli/C/CurrentInfectiousDiseaseReports2008_10_1_22.pdf)  
Boyd RW (2008) *Nonlinear Optics.* Academic Press, London.  
Kocielek MG. (2009) Quorum-Sensing Inhibitors and Biofilms. *Anti-Infective Agents in Medicinal Chemistry* 8,

315-326 <http://benthamscience.com/cmcaia/sample/aiamc8-4/0004Y.pdf>  
 Falagas ME, Kapaskelis AM, Kouranos VD, et al. (2009) Outcome of antimicrobial therapy in documented biofilm-associated infections: a review of the available clinical evidence. *Drugs*. 69(10),1351-61.  
<http://www.ncbi.nlm.nih.gov/pubmed/19583453>  
 Gutierrez JA, Crowder T et al (2009) Transition state analogs of 5'-methylthioadenosine nucleosidase disrupt quorum sensing. In: *Nature Chemical Biology*. Online-Veröffentlichung. doi:10.1038/nchembio.153  
 Ponnusamy K et al (2010) 2(5H)-Furanone: a prospective strategy for biofouling-control in membrane biofilm bacteria by quorum sensing inhibition. *Braz. J. Microbiol.* vol.41 no.1 São Paulo Jan./Mar. 2010  
<http://dx.doi.org/10.1590/S1517-83822010000100032>  
 Bassler B (2010) *Vibrio Cholerae* Quorum Sensing and Novel Antibiotics  
<https://www.youtube.com/watch?v=k-CkqlePaqI&app=desktop>  
 « Antivirulence activity by Quorum sensing. Turning off the light switch by CAI-1, (3-(S)-hydroxy-4-tridecanone. A 13S Molecule) »  
 Soscia SJ, Kirby JE, Washicosky KJ, et al. (2010) The Alzheimer's disease-associated amyloid beta-protein is an antimicrobial peptide. In: *PLoS ONE*. 5, Nr. 3, S. e9505.  
 doi:10.1371/journal.pone.0009505. PMID 20209079. Volltext bei PMC: 2831066.  
<http://de.wikipedia.org/wiki/Methylenblau> <http://news.bbc.co.uk/2/hi/health/7525115.stm>  
 Rogers SA, Huigens RW, Cavanagh J, Melander C. (2010) Synergistic Effects between Conventional Antibiotics and 2-Aminoimidazole-Derived Antibiofilm Agents. *Antimicrobial Agents And Chemotherapy*. 2112–2118 <http://aac.asm.org/content/54/5/2112.short>  
 Köhler T, Perron GG, Buckling A, van Delden C. (2010) Quorum Sensing Inhibition Selects for Virulence and Cooperation in *Pseudomonas aeruginosa*. Issue of *PLoS Pathogens*  
<http://www.plospathogens.org/article/info:doi/10.1371/journal.ppat.1000883>  
 Rasmussen TB, Bjarnsholt T, Skindersoe ME et al. (2005) Screening for Quorum-Sensing Inhibitors (QSI) by Use of a Novel Genetic System, the QSI Selector. *J Bacteriol.* Mar 187(5), 1799–1814. doi: 10.1128/JB.187.5.1799-1814.2005 PMID: PMC1063990  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1063990/>  
 Lowery CA, Salzameda NT, Sawada D et al. (2010) Medicinal chemistry as a conduit for the modulation of quorum sensing. *J Med Chem* 53, 7467-7489.  
 Marsden DM, Nicholson RL, Skindersoe ME et al. (2010) Discovery of a quorum sensing modulator pharmacophore by 3D small-molecule microarray screening. *Org Biomol Chem* 8, 5313-5323.  
 Maezono H, Noiri Y, Asahi Y, et al. (2011) Antibiofilm effects of azithromycin and erythromycin on *Porphyromonas gingivalis*. *Antimicrob Agents Chemother* 55(12), 5887-92.  
 Sambanthamoorthy K, Gokhale AA, Lao W. et al. (2011) Identification of a Novel Benzimidazole That Inhibits Bacterial Biofilm Formation in a Broad-Spectrum Manner. *ANTIMICROBIAL AGENTS AND CHEMOTHERAPY*, p. 4369–4378 <https://www.msu.edu/~watersc3/publication.html>  
 Valenti P, Catizone A, Pantanella F, et al. (2011) Lactoferrin decreases inflammatory response by cystic fibrosis bronchial cells invaded with *Burkholderia cenocepacia* iron-modulated biofilm. *Int J Immunopathol Pharmacol* 24(4), 1057-68.  
 Petrova NV, Shevchenko VP, Pavlov VV, et al. (2012) Criteria of antibacterials choice for prophylaxis and therapy of implant-associated infections in prosthetic joints. *Antibiot Khimioter* 57(3-4), 45-9.  
 Worthington RJ, Richards JJ, Melander C (2012) Small molecule control of bacterial biofilms. *Org Biomol Chem*. 10(37), 7457-74. <http://www.ncbi.nlm.nih.gov/pubmed/22733439>  
 Lebeaux D, Ghigo JM (2012) Management of biofilm-associated infections: what can we expect from recent research on biofilm lifestyles? *Med Sci (Paris)* 28(8-9), 727-39.  
 Vogel HJ (2012) Lactoferrin, a bird's eye view. *Biochem Cell Biol* 90(3), 233-44. [Abstract](#)  
 Kalia VC (2013) Quorum sensing inhibitors: An overview. *Biotechnology Advances* Volume 31(2), 224–245  
<http://www.sciencedirect.com/science/article/pii/S0734975012001851>  
 Kumar S et al. (2013) Novel Quorum-Sensing Peptides Mediating Interspecies Bacterial Cell Death. *mBio* 4 (3) e000314-13. doi:10.1128/mBio00314-13.  
<http://mbio.asm.org/content/4/3/e00314-13.full>  
 Conlon BP et al. (2013) Activated ClpP kills persisters and eradicates a chronic biofilm infection, *Nature*, doi:10.1038/nature12790. <http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12790.html>  
 Neuartiges Antibiotikum beseitigt hartnäckige Infektionen  
[http://www.wissenschaft-aktuell.de/artikel/Neuartiges\\_Antibiotikum\\_beseitigt\\_hartnaeckige\\_Infektionen1771015589395.html](http://www.wissenschaft-aktuell.de/artikel/Neuartiges_Antibiotikum_beseitigt_hartnaeckige_Infektionen1771015589395.html)  
 „Als besonders vielversprechend erwies sich die antibiotisch wirksame Substanz ADEP (Acyldepsipeptid)... ADEP4 aktiviert das eiweißspaltende Enzym ClpP der Bakterien. Diese Protease dient normalerweise nur dazu, fehlerhafte Proteine zu entsorgen. Die Anlagerung von ADEP4 hat zur Folge, dass das Enzym unkontrolliert und wahllos zahlreiche Proteine zerstört, so dass die Mikroben absterben. Dieser Effekt trat auch bei nicht wachsenden Zellen von *Staphylococcus aureus* ein. Zwar ist – wie bei allen Antibiotika – damit zu rechnen, dass sich mit der Zeit Mutanten entwickeln, die gegen ADEP4 resistent geworden sind. Experimente zeigten aber, dass sich diese dann leicht durch



bekannte Antibiotika wie Rifampicin oder Ciprofloxacin beseitigen ließen. Mit einer Kombination aus ADEP4 und Rifampicin konnten die Forscher Staphylokokken in Laborkulturen auch dann vollständig eliminieren, wenn sie Biofilme gebildet hatten.“

Bjarnsholt T, Ciofu O et al. (2013) Applying insights from biofilm biology to drug development – can a new approach be developed? *Nature Reviews Drug Discovery* 12, 791-808

<https://www.nature.com/articles/nrd4000>

Burt SA, Ojo-Fakunle VTA, Woertman J, Veldhuizen EJA (2014) The Natural Antimicrobial Carvacrol Inhibits Quorum Sensing in Chromobacterium violaceum and Reduces Bacterial Biofilm Formation at Sub-Lethal Concentrations. *PLoS ONE* 9(4): e93414. doi:10.1371/journal.pone.0093414

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0093414>

Padmavathi AR, Abinaya B, Pandian SK (2014) Phenol, 2,4-bis(1,1-dimethylethyl) of marine bacterial origin inhibits quorum sensing mediated biofilm formation in the uropathogen *Serratia marcescens*. *Biofouling: The Journal of Bioadhesion and Biofilm Research*. 30(9), 1111-1122 DOI:10.1080/08927014.2014.972386

<http://www.tandfonline.com/doi/abs/>

Borges A, Saavedra MJ, Simoes M (2015) Insights on Antimicrobial Resistance, Biofilms and the Use of Phytochemicals as New Antimicrobial Agents. *Current Medicinal Chemistry* 22, 2590-2614

<http://www.ncbi.nlm.nih.gov/pubmed/26028341>

Zhang W, Li Ch (2015) Exploiting Quorum Sensing Interfering Strategies in Gram-Negative Bacteria for the Enhancement of Environmental Applications. *Front Microbiol*. 6, 1535.

Published online 2016 Jan 8. doi: 10.3389/fmicb.2015.01535 PMID: PMC4705238

PMID: 26779175 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4705238/>

Brackman G, Coenye T (2015) Quorum Sensing Inhibitors as Anti-Biofilm Agents. *Current Pharmaceutical Design*, 21, 000-000 1 1381-6128/15 \$58.00+.00 © 2015 Bentham Science Publishers

[https://www.researchgate.net/publication/265393991\\_Quorum\\_Sensing\\_Inhibitors\\_as\\_Anti-Biofilm\\_Agents](https://www.researchgate.net/publication/265393991_Quorum_Sensing_Inhibitors_as_Anti-Biofilm_Agents)

O'Connor G, Knecht LD, Salgado N et al. (2015) Whole-Cell Biosensors as Tools for the Detection of Quorum-Sensing Molecules: Uses in Diagnostics and the Investigation of the Quorum-Sensing Mechanism.

*Adv Biochem Eng Biotechnol*. <https://www.ncbi.nlm.nih.gov/pubmed/26475469>

Wu H, Moser C, Wang H-Z et al. (2015) Strategies for combating bacterial biofilm infections. *Int J Oral Sci*. 7(1), 1–7. Published online 2014 Dec 12. doi: 10.1038/ijos.2014.65 PMID: PMC4817533

PMID: 25504208 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4817533/>

« We conclude that, an efficient treatment of biofilm infections needs a well-established multidisciplinary collaboration, which includes removal of the infected foreign bodies, selection of biofilm-active, sensitive and well-penetrating antibiotics, systemic or topical antibiotic administration in high dosage and combinations, and administration of anti-quorum sensing or biofilm dispersal agents ».

Rabin N, Zheng Y, Opoku-Temeng C et al. (2015) **Agents that inhibit bacterial biofilm formation.** *Future Medicinal Chemistry* Vol. 7, No. 5 Review. Published Online:29 Apr 2015 <https://doi.org/10.4155/fmc.15.7>

<https://www.future-science.com/doi/full/10.4155/fmc.15.7>

« These new antibiofilm agents, which contain moieties such as imidazole, phenols, indole, triazole, sulfide, furanone, bromopyrrole, peptides, etc. have the potential to disperse bacterial biofilms *in vivo* and could positively impact human medicine in the future. »

Ribeiro SM, Felicio MR, Boas EV et al. (2016) New frontiers for anti-biofilm drug development. *Pharmacology & Therapeutics* 10, 133-144 <https://www.sciencedirect.com/science/article/pii/S0163725816000358>

Huges G (2017) Novel approaches to the treatment of bacterial biofilm infections. *British Journal of Pharmacology*. 174, 2237-2246 [Phages, Blue light...]

<https://bpspubs.onlinelibrary.wiley.com/doi/pdf/10.1111/bph.13706>

Koo H, Raymond N et al. (2017) Targeting microbial biofilms: current and prospective therapeutic strategies. *Nature reviews. Microbiology*.

[« MAIN STRATEGIES to INTERFERE: Adherence, Extracellular polymeric substance (EPS) matrix, Architecture, Viscoelasticity, Heterogeneity, Developmental life cycle, Diffusible cell signals, Altered microenvironment formation Dormant or slow growing sub-populations »]

Liu MY, Cokcetin NN1, Lu J (2018) Rifampicin-Manuka Honey Combinations Are Superior to Other Antibiotic-Manuka Honey Combinations in Eradicating *Staphylococcus aureus* Biofilms.

*Front Microbiol*. 8, 2653. doi: 10.3389/fmicb.2017.02653. eCollection 2017.

<https://www.ncbi.nlm.nih.gov/pubmed/29375518>

Lacout A, Dacher V, El Hajjam M, Marcy PY, Perronne C (2018) Biofilms busters to improve the detection of *Borrelia* using PCR. *Med Hypotheses*. 112, 4-6. doi: 10.1016/j.mehy.2018.01.005. Epub 2018 Jan 30.

<https://www.ncbi.nlm.nih.gov/pubmed/29447935>

« Using biofilm busters, such as stevia and serratiopeptidase, could lead to bacterial blood release, thus increasing the spirochete load, making PCR test more sensitive, thus improving the patient's diagnosis and management. »

Sang-Ryoung Kim, Kyung-Min Yeon (2018) Chapter Two - Quorum Sensing as Language of Chemical Signals. <https://doi.org/10.1016/bs.coac.2018.03.01>

Lu L, Hu W et al. (2019) Developing natural products as potential antibiofilm agents. *Chinese Medicine* 14

(11) <https://cmjournal.biomedcentral.com/articles/10.1186/s13020-019-0232-2>

[« Garlic extract, Polyphenols (Cranberries), Quercetin « ]

Nattokinase, Serrapeptase <http://www.serrapeptase.org/serrapeptase-reviews/best-systemic-enzyme/>

ClinicalTrials.gov Identifier: NCT03891667 (2019) Disulfiram: A Test of Symptom Reduction Among Patients With Previously Treated Lyme Disease. <https://clinicaltrials.gov/ct2/show/NCT03891667#outcomemeasures>

HZI Helmholtz Zentrum für Infektionsforschung, Publikationen (2019) Titz A, Lectin Inhibitoren.

<https://www.helmholtz-hzi.de/de/forschung/forschungsschwerpunkte/neue-wirkstoffe/chemische-biologie-der-kohlenhydrate/publikationen/#anchorsection>

Liegner KB (2019) Disulfiram (Tetraethylthiuram Disulfide) in the Treatment of Lyme Disease and Babesiosis: Report of Experience in Three Cases. *Antibiotics (Basel)*. 8(2). pii: E72. doi: 10.3390/antibiotics8020072

Hwang G, Paula AJ, Hunter EE et al. (2019) Catalytic antimicrobial robots for biofilm eradication. *Science Robotics* 4(29), eaaw2388. DOI: 10.1126/scirobotics.aaw2388

<https://robotics.sciencemag.org/content/4/29/eaaw2388>

« We demonstrate applications of CARs to target highly confined anatomical surfaces in the interior of human teeth. These "kill-degrade-and-remove" CARs systems may fight persistent biofilm infections and mitigate biofouling of medical devices and diverse surfaces. »

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## 2.8 Horizontal gene transfer, Autoimmunity, Tumor neogenesis

<http://www.erlebnishaft.de/gentransfer.pdf>

Sonea S, Panisset M (1983) *A New Bacteriology*. Jones and Barlett Publishers, Inc. Boston  
ISBN 0-86720-024-3

Zinder ND, Lederberg J (1992, 1952) Genetic Exchange in Salmonella. *J Bacteriol* 64, 679-699 in Forty Years ago: The Discovery of Bacterial Transduction. *Perspectives, The Genetic Society of America*. 132, 291-294

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC169409/>

Hoffmann T, Golz C, Schieder, O (1994) Foreign DNA sequences are received by a wild type strain of *Aspergillus niger* after co-culture with transgenic higher plants *Current Genetics* 27, 70-76

Lorenz MG, Wackernagel W (1994) Bacterial gene transfer by natural genetic transformation in the environment. *Microbiological Reviews* 58, 563-602

Mitten D, Redenbaugh K, Lindemann J (1996) Evaluation of potential gene transfer from transgenic plants, transgenic organisms and biosafety. In: *Horizontal gene transfer stability of DNA and expression of transgenes*. Eds.: Schmidt, E.R., Hankeln, T. pp.95-100, Springer Heidelberg

Clerc S, Simonet P (1998) A review of available systems to investigate transfer of DNA to indigenous soil bacteria. *Antonie van Leeuwenhoek* 73, 15-23

Dröge M, Pühler A, Selbitschka W (1998) Horizontal gene transfer as a biosafety issue: A natural phenomenon of public concern. *Journal of Biotechnology* 64, 75-90

Nielsen KM, Bones AM, Smalla K, van Elsas JD (1998) Horizontal gene transfer from transgenic plants to terrestrial bacteria – a rare event? *FEMS Microbiology Reviews* 22, 79-103

Bertolla F, Simonet P (1999) Horizontal gene transfers in the environment: natural transformation as a putative process for gene transfers between transgenic plants and microorganisms. *Research Microbiology* 150, 375-384

Smalla K, Osborn M, Wellington EMH. (2000) Isolation and characterisation of plasmids from bacteria. In Thomas CM (Hg.) *The horizontal gene pool - bacterial plasmids and gene spread*. Harwood academic publishers. S. 207-248.

Smalla K, Krögerrecklenfort E, Heuer H et al. (2000) PCR-based detection of mobile genetic elements in total community DNA. *Microbiology* 146:1256-1257.

Ochman H, Lawrence JG, Groisman EA (2000) [Lateral gene transfer and the nature of bacterial innovation](#). *NATURE*. 405.

[http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Ochman2000\\_Lateral\\_transfer\\_bacterial\\_DNA.pdf](http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Ochman2000_Lateral_transfer_bacterial_DNA.pdf)

Koonin EV, Makarova KS, Aravind L (2001) Horizontal Gene Transfer in Prokaryotes: Quantification and Classification. *Annu. Rev. Microbiol.* 55, 709 – 42. <http://www.ncbi.nlm.nih.gov/books/NBK2228/>

Salzberg SL et al. (2001) Microbial genes in the human genome: Lateral transfer or gene loss? *Science*, 292, 1903-06.

Bushman F (2002) *Lateral DNA Transfer mechanisms and Consequences*. Cold Spring Harbor Laboratory Press, cold Spring Harbor, New York

Margulis L, Sagan D (2002, 2003) *Acquiring Genomes: A Theory of the Origins of Species*, Perseus Books



Group,

Van Elsas JD, Turner S, Bailey MJ. (2003) Horizontal gene transfer in the phytosphere. *New Phytologist* 17, 525-537

Munksgaard L, Obitz ER, Goodlad JR et al. (2004) Demonstration of *B. burgdorferi*-DNA in Two Cases of Nod-ai Lymphoma. *Leukemia & Lymphoma*, 45, 1721-1723.

<http://dx.doi.org/10.1080/10428190410001683723>

Qiu W-G, Schutzer SE, Bruno JF (2004) Genetic exchange and plasmid transfers in *Borrelia burgdorferi* sensu stricto revealed by three-way genome comparisons and multilocus sequence typing. *Proc Natl Acad Sci U S A*. 101(39), 14150-5. <http://www.ncbi.nlm.nih.gov/pubmed/15375210>

[http://www.pnas.org/content/101/39/14150.full?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=borrelia&searchid=1096492260484\\_7703&stored\\_search=&FIRSTINDEX=0&volume=101&issue=39](http://www.pnas.org/content/101/39/14150.full?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=borrelia&searchid=1096492260484_7703&stored_search=&FIRSTINDEX=0&volume=101&issue=39)

Hartmann A (2005) Horizontaler Gentransfer, ein natürlicher Prozess. *mensch+umwelt spezial* 17. Ausgabe [http://www.helmholtz-muenchen.de/fileadmin/GSF/pdf/publikationen/mensch\\_und\\_umwelt\\_spezial/Heft17/59\\_64\\_Hartmann.pdf](http://www.helmholtz-muenchen.de/fileadmin/GSF/pdf/publikationen/mensch_und_umwelt_spezial/Heft17/59_64_Hartmann.pdf)

„Unter natürlichen Bedingungen ist jedoch der horizontale Gentransfer und die Etablierung von Genen in fremden Organismen im Allgemeinen als praktisch vernachlässigbar einzuschätzen.“

MacDonald AB (2006) Transfection “Junk” DNA—A link to the pathogenesis of Alzheimer’s disease? *Medical Hypotheses* 66(6) 1140-1141

Sridhar Rao PN (2006) [Article on mechanisms of DNA Transfer.](#)

[http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Lateral\\_DNA\\_transfer\\_By\\_Dr\\_Rao\\_PDF.pdf](http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Lateral_DNA_transfer_By_Dr_Rao_PDF.pdf)

Choi CQ (2007) Bacterial genes jump to host. Frequent lateral gene transfer from bacteria to their host organisms may be a mechanism for hosts' evolution. *The Scientist – Magazine of the Life Sciences*.

<http://classic.the-scientist.com/news/display/53552/#ixzz1CMT0DtIz>

Dunning Hotopp JC et al. (2007) Widespread Lateral Gene Transfer from Intracellular Bacteria to Multicellular Eukaryotes. Read more: Bacterial genes jump to host - The Scientist - Magazine of the Life Sciences

<http://classic.the-scientist.com/news/display/53552/#ixzz1CMQmPXcy>

Ho M-W, Cummins J. (2008) Horizontal Gene Transfer from GMOs Does Happen, ISIS,

<http://www.i-sis.org.uk/horizontalGeneTransfer.php>

Pudztai A, Bardocz S (2009) Sicherheitsrisiko Gentechnik. orange press. ISBN: 987-3-986086-50-8

McGinty S, Rankin DJ, Brown SP. (2011) Horizontal gene transfer and the evolution of bacterial cooperation. *Evolution* 65, 21-32. <http://onlinelibrary.wiley.com/doi/10.1111/j.1558-5646.2010.01121.x/full>

Schröder G, Schuelein R, Quebatte M, Dehio C. (2011) Conjugative DNA transfer into human cells by the VirB/VirD4 type IV secretion system of the bacterial pathogen *Bartonella henselae*. *Proc Natl Acad Sci U S A*. 108(35), 14643-8. doi: 10.1073/pnas.1019074108. doi:10.1073/pnas.1019074108. PMID 21844337.

[PMC 3167556 microbewiki.kenyon.edu/index.php/Bartonella\\_henselae](http://www.pnas.org/content/108/35/14643)

<http://www.pnas.org/content/108/35/14643>

Anderson MT, Seifert HS. (2011) Opportunity and means: horizontal gene transfer from the human host to a bacterial pathogen. *MBio* 2(1), e00005-11. [Abstract](#)

Leister D, Kleine T (2011) Role of intercompartmental DNA transfer in producing genetic diversity. *Int Rev Cell Mol Biol* 2011, 73-114. [Abstract](#)

Guinane CM, Penadés JR, Fitzgerald JR (2011) The role of horizontal gene transfer in *Staphylococcus aureus* host adaptation. *Virulence* 2(3), 241-3. [Abstract](#)

Sinkovics JG (2011) Horizontal gene transfers with or without cell fusions in all categories of the living matter. *Adv Exp Med Biol* 5-89. [Abstract](#)

Das Biotechnologie und Life Sciences Portal Baden-Württemberg. (2012) Horizontaler Gentransfer bei Endosymbiosen. <http://www.bio-pro.de/magazin/index.html?lang=de&artikelid=/artikel/07887/index.html>

Moran Y, Fredman D, Szczesny P. et al. (2012) Recurrent Horizontal Transfer of Bacterial Toxin Genes to Eukaryotes *Mol Biol Evol* 4 mss089v2-mss089.

<http://mbe.oxfordjournals.org/content/early/2012/04/04/molbev.mss089.full.pdf+html>

Yue J et al. (2012) Wide spread impact of horizontal gene transfer on plant colonization of land. *Nature Communications*. doi:10.1038/ncomms2148.

Robinson KM, Sieber KB, Dunning Hotopp JC (2013) A Review of Bacteria-Animal Lateral Gene Transfer May Inform Our Understanding of Diseases like Cancer. *PLoS Genet* 9(10), e1003877.

doi:10.1371/journal.pgen.1003877

<http://www.plosgenetics.org/article/info%3Adoi%2F10.1371%2Fjournal.pgen.1003877>

„Lateral gene transfer (LGT) from bacteria to animals occurs more frequently than was appreciated prior to the advent of genome sequencing. ... In this review, we propose that such non inherited bacterial DNA integration into chromosomes in human somatic cells could induce mutations leading to cancer or autoimmune diseases in a manner analogous to mobile elements and viral integrations.“

Robinson KM, Dunning Hotopp JC (2014) Mobile elements and viral integrations prompt considerations for bacterial DNA integration as a novel carcinogen. *Cancer Lett*, 352, 137-44.

Riley DR et al. (2013) Bacteria-human somatic cell lateral gene transfer is enriched in cancer samples. *PLOS*

Comput Biol, 9, e1003107

Boto L (2014) Horizontal gene transfer in the acquisition of novel traits by metazoans. Proc. R. Soc. B 281, 20132450 <http://rspsb.royalsocietypublishing.org/content/281/1777/20132450>

<http://rspsb.royalsocietypublishing.org/content/royprsb/281/1777/20132450.full.pdf>

Mayoral J et al. (2014) Wolbachia small noncoding RNAs and their role in cross-kingdom communications. PNAS, doi:10.1073/pnas.1420131112

Crisp A et al. (2015) Expression of multiple horizontally acquired genes is a hallmark of both vertebrate and invertebrate genomes. doi:10.1186/s13059-015-0607-3, Genome Biology. 16, 50

<http://genomebiology.com/2015/16/1/50>

„We argue that HGT has occurred, and continues to occur, on a previously unsuspected scale in metazoans and is likely to have contributed to biochemical diversification during animal evolution.“

Chrostek E, Pelz-Stelinski K, Hurst GDD, Hughes GL (2017) Horizontal Transmission of Intracellular Insect Symbionts via Plants. *Front Microbiol.* 8, 2237. doi: 10.3389/fmicb.2017.02237. eCollection 2017.

<https://www.ncbi.nlm.nih.gov/pubmed/29234308> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5712413/>

„Transmission of symbionts through plants likely represents an underappreciated means of infection, both in terms of symbiont epidemiology and the movement of symbionts to new host species.“

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.9 Tetracyclines and Tumor therapy**

Fife RS, Sledge GW Jr (1995) Effects of doxycycline on in vitro growth, migration, and gelatinase activity of breast carcinoma cells. *J Lab Clin Med.* 125(3), 407-11. <https://www.ncbi.nlm.nih.gov/pubmed/7897308>

Fife RS, Rougraff BT, Proctor C, Sledge GW Jr (1997) Inhibition of proliferation and induction of apoptosis by doxycycline in cultured human osteosarcoma cells. *J Lab Clin Med.* 130(5), 530-4.

<https://www.ncbi.nlm.nih.gov/pubmed/9390641>

Fife RS, Sledge GW Jr, Roth BJ, Proctor C (1998) Effects of doxycycline on human prostate cancer cells in vitro. *Cancer Lett.* 127(1-2), 37-41. <https://www.ncbi.nlm.nih.gov/pubmed/9619856>

Saikali Z, Singh G (2003) Doxycycline and other tetracyclines in the treatment of bone metastasis. *Anticancer Drugs.* 14(10), 773-8. <https://www.ncbi.nlm.nih.gov/pubmed/14597870>

Onoda T, Ono T, Dhar DK, Yamanoi A, Fujii T, Nagasue N (2004) Doxycycline inhibits cell proliferation and invasive potential: combination therapy with cyclooxygenase-2 inhibitor in human colorectal cancer cells. *J Lab Clin Med.* 143(4), 207-16. <https://www.ncbi.nlm.nih.gov/pubmed/15085079>

<https://www.ncbi.nlm.nih.gov/pubmed/15085079>

Lokeshwar BL (2011) Chemically modified non-antimicrobial tetracyclines are multifunctional drugs against advanced cancers. *Pharmacol Res.* 63(2) 146-50. <https://www.ncbi.nlm.nih.gov/pubmed/21093590>

<http://www.sciencedirect.com/science/article/pii/S1043661810002161>

«Matrix metalloproteinases (MMPs) make up the majority of ECM degrading enzymes implicated in cancer metastasis. The potent MMP inhibitory activities of tetracyclines, especially their chemically modified analogs, combined with their relatively well tolerated pharmacological profile, led several researchers to investigate their anticancer potential in a variety of cancers, including melanoma, lung, breast and prostate cancers. «

Regen F, Heuser I, Herzog I, Hellmann-Regen J (2014) Striking growth-inhibitory effects of minocycline on human prostate cancer cell lines. *Urology.* 83(2), 509.e1-6. doi:10.1016/j.urology.2013.10.029.

<https://www.ncbi.nlm.nih.gov/pubmed/24360070>

Lamb R, Ozsvari B, Lisanti CL et al. (2015) Antibiotics that target mitochondria effectively eradicate cancer stem cells, across multiple tumor types: Treating cancer like an infectious disease. *Oncotarget.* 6, 4569-4584. doi: 10.18632/oncotarget.3174 PDF | HTML | Order a Reprint

<http://www.impactjournals.com/oncotarget/index.php?journal=oncotarget&op=view&page=article&path%5B%5D=3174>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4467100/>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.10 Symbiosis, self organization, Nucleolus, Pattern matching**

### **Symbiosis**

De Bary A (1878) Die Erscheinung der Symbiose. Verlag von Karl J. Trubner, Strassburg. [SYMBIOSE]

Mereschkowsky C (1905) Über Natur und Ursprung der Chromatophoren Im Pflanzenreiche. Biologisches Zentralblatt XXV, 18 [SYMBIOGENESE]

Mereschkowsky C (1910, 1920) Theorie der Symbiogenese. Zell-Evolution durch Integration und Kooperation. Kutschera U Tatsache Evolution 3 A München 2010

Wolbach SB (1919) Studies on Rocky Mountain Spotted Fever. J Med Res 41, 1-197  
<https://archive.org/details/studiesonrockymo00wolb> [INTRANUCLEAR FORMS, S. 80, 83-86, 106-115]

Kozo-Polyansky BM (1924, 2010) Symbiogenesis. A new principle of Evolution. Harvard University Press. ISBN 978-0-674-05045-7

Wallin IE (1927) BACTERIA AND THE ORIGIN OF SPECIES. Science. 64(1651), 173-5.

Margulis L (1970) Origin of Eukaryotic Cells, Yale University Press, [THE ENDOSYMBIOSIS HYPOTHESIS]

Margulis L, Sagan D (1986) Microcosmos. Four billion Years of Microbial Evolution. New York S. 15 ISBN 0-502-21064-6

Margulis L (1990) Words as battle cries – symbiogenesis and the new field of endocytobiology. BioScience 40, 673–677.

Margulis L. (1993) Symbiosis in Cell Evolution. Microbial Communities in the Archean and Proterozoic Eons. (2.ed.) New York, Freeman and Co. ISBN 0-7167-7029-6.

Margulis L (1999) Die andere Evolution. Spektrum. ISBN 3-8274-0294-8

Margulis L, Sagan D (2002) Acquiring Genomes. A Theory of the Origins of Species. Basic Books. ISBN 0-465-04391-7

Margulis M et al. (2011) Chimeras and Consciousness. Evolution of the Sensory Self. The MIT Press. ISBN 978-0-262-51583-2 (s.a. <http://www.quantumconsciousness.org/>)

Taylor FJR (1979) Symbiogenesis revisited: a discussion of the evolutionary impact of intracellular symbioses. Proc. R. Soc. Lond. B 204, 267–286.

Schwemmler W, Schenk HEA (Eds.) (1980) Endocytobiology. Endosymbiosis and Cell Biology. Walter de Gruyter & Co., Berlin, New York.

Sitte P, (1989) Phylogenetische Aspekte der Zellevolution. Biol. Rundsch. 28, 1–18.

Sitte P, (1991) Die Zelle in der Evolution des Lebens. Biol. in unserer Zeit 21, 85–92

Sitte P, (1994) Die Evolution von Zellen: Innovation durch Symbiogenese. In: Wieser, W. (Ed.), Die Evolution der Evolutionstheorie. Von Darwin zur DNA. Spektrum Akademischer Verlag, Berlin, Heidelberg, pp. 77–108.

Sitte P, (2001) Symbiogenese in der Zell- und Lebensentwicklung. In: Storch, V., Welsch, U., Wink, M. (Eds.), Evolutionsbiologie. Springer, Berlin, Heidelberg, pp. 196–208.

Preparata G (1995) QED Coherence in Matter. World Scientific. ISBN 9810222491

Lang BF, Gray MW, Burger G (1999) Mitochondrial genome evolution and the origin of eukaryotes. Annu. Rev. Genet. 33, 351–397

Hentschel U, Steinert M, Hacker J, (2000) Common molecular mechanisms of symbiosis and pathogenesis. Trends in Microbiology, 8, 226–231

van den Ent F, Amos LA, Löwe J. (2001) Prokaryotic origin of the actin cytoskeleton. Nature. 413(6851), 39-44. <http://www.ncbi.nlm.nih.gov/pubmed/11544518>  
[https://www.researchgate.net/publication/11801095\\_Prokaryotic\\_origin\\_of\\_the\\_actin\\_cytoskeleton?cp=re217\\_x\\_p6&ch=req&login=bhuismans@t-online.de&pli=1](https://www.researchgate.net/publication/11801095_Prokaryotic_origin_of_the_actin_cytoskeleton?cp=re217_x_p6&ch=req&login=bhuismans@t-online.de&pli=1)

van den Ent F, Amos L, Löwe J. (2001) Bacterial ancestry of actin and tubulin. Curr Opin Microbiol. 4(6), 634-8. <http://www.ncbi.nlm.nih.gov/pubmed/11731313>

Kutschera U (2001) Evolutionsbiologie. Eine allgemeine Einführung. Parey Buchverlag, Berlin.

Kutschera U (2002) Bacterial colonization of sunflower cotyledons during seed germination. J. Appl. Bot. 76, 96–98.

Kutschera U, Niklas KJ (2004) The modern theory of biological evolution: an expanded synthesis. Naturwissenschaften 91, 255–276.

Kutschera U, Niklas KJ (2005) Endosymbiosis, cell evolution, and speciation. Theory in Biosciences, 124, 1–24. DOI:10.1016/j.thbio.2005.04.001, Source [PubMed](https://pubmed.ncbi.nlm.nih.gov/)  
[https://www.researchgate.net/publication/6749988\\_Endosymbiosis\\_cell\\_evolution\\_and\\_speciation](https://www.researchgate.net/publication/6749988_Endosymbiosis_cell_evolution_and_speciation)

Kutschera, U. (2009) Symbiogenesis, natural selection, and the dynamic Earth. Theory Biosci. 128, Nr 3 DOI 10.1007/s12064-009-0065-0, 191 – 203. . [Abstract](#)

Kutschera U (2009) Charles Darwin's Origin of Species, directional selection, and the evolutionary sciences today. Naturwissenschaften 96(11)1247-63. [Abstract](#)

Kutschera U (2011) From the scala naturae to the symbiogenetic and dynamic tree of life. Biol Direct 33. [Abstract](#)

Kutschera U (2012) VIDEO Was ist Symbiogenese? Tatsache Evolution - Was Darwin nicht wissen konnte. <http://www.youtube.com/watch?v=NhCZJsvOwtU>

Sapp J, Carrapiço F, Zolotonosov M (2002) Symbiogenesis: the hidden face of Constantin Merezhkowsky. In: History and philosophy of the life sciences. 24, Nr. 3-4, 413–40. doi:10.1080/03919710210001714493. PMID [15045832](https://pubmed.ncbi.nlm.nih.gov/15045832/).

Kuznetsov AP, Lebkova NP (2002) On bacterial origin of mitochondria in Eukaryotes in light of current ideas

of evolution of the organic world. *Biol. Bull.* 29, 501–507.

Hoffmeister M, Martin W (2003) Interspecific evolution: microbial symbiosis, endosymbiosis and gene transfer. *Environmental Microbiology*, 5, 641–649.

Dyall SD, Brown MT, Johnson PJ (2004) Ancient invasions: from endosymbionts to organelles. In: *Science*. Nr. 304(5668), 253-257

Peter Sitte (2004) Wesen, Werden und Wachsen der Lebenswelt, in: Hans Gebhardt, Helmuth Kiesel (Hg.), *Weltbilder*, Springer, 92.

Fokin SI (2004) Bacterial endocymbionts of Ciliophora and their interactions with the host cell. *Int Rev Cytol.* 236, 181-249 <http://www.ncbi.nlm.nih.gov/pubmed/15261739>

Sapp J, (2004) The dynamics of symbiosis: an historical overview. *Canadian Journal of Botany*, 82, 1046–1056. [SYMBIOTISM]

Chapman M, Alliegro MC (2007) A symbiogenetic origin for the centrosome? *Symbiosis*, 44, 23-31.

Huisman BD (2007) Lebendigkeit - Selbstorganisation - Morphogenese: 5. Hauptsatz der Thermodynamik, das Phanomen Sound Theorem. <http://www.hausarbeiten.de/faecher/vorschau/71284.html>

Ryan FP (2007) Viruses as symbionts. *Symbiosis* 44, 13–39

Alliegro, MC, Satir P (2009) Origin of the Cilium: Novel approaches to examine a centriolar evolution hypothesis. *Meth. Cell Biol.* 94:51-63 <http://www.ncbi.nlm.nih.gov/pubmed/20362084>

Alliegro MC (2011) The centrosome and spindle as a ribonucleoprotein complex. *Chrom. Res.* 19, 367-376. <http://www.ncbi.nlm.nih.gov/pubmed/21287260>

Alliegro MC, Hartson S, Alliegro, MA. (2012) Composition and dynamics of the nucleolus, a physiological link between the nucleolus and cell division apparatus. *J. Biol. Chem.*

Reyes CP, La Clair JJ, Burkart MD (2010) Metabolic probes for imaging endosymbiotic bacteria within toxic dinoflagellates. *Chem. Commun.*, 46, 8151-8153 DOI: 10.1039/C0CC02876B <http://pubs.rsc.org/en/Content/ArticleLanding/2010/CC/C0CC02876B>

Senkbach J, Grube M (2010) Symbioses and Stress. *Joint Ventures in Biology*. Springer. ISBN 978-90-481-9448-3

Zielinski F, Dubilier N (2010) Der Eukaryoten-Zellkern als ökologische Nische für Bakterien. *BioSpektrum* 01-10 16 p.12-15 [http://www.biospektrum.de/blatt/d\\_bs\\_pdf&\\_id=1021478](http://www.biospektrum.de/blatt/d_bs_pdf&_id=1021478)

Rumpo ME, Pelletreau KN, Moustafa A et al. (2011) The making of a photosynthetic animal. *The journal of Experimental Biology* 214, 303-311 (Mereschkowsky C (1905) “Eine Pflanzenzelle ist eine Tierzelle mit eingedrungenen Cyanobakterien“

Dattagupta Sh, Zielinski F (2011) Symbiosis. *Encyclopedia of Geobiology*. Springer Netherlands 866-870 DOI 10.1007/978-1-4020-9212-1\_228 Print ISBN 978-1-4020-9211-4 Online ISBN 978-1-4020-9212-1 [http://link.springer.com/referenceworkentry/10.1007%2F978-1-4020-9212-1\\_228#page-1](http://link.springer.com/referenceworkentry/10.1007%2F978-1-4020-9212-1_228#page-1)

„Thus, a natural continuum exists among mutualism, commensalism, and parasitism, and arguments about restricting the definition of symbiosis only serve to obscure a true understanding of the phenomenon.“

Schönknecht G et al. (2013) Gene transfer from bacteria and archaea facilitated evolution of an extremophilic eukaryote. *Science*, 339, 1207-10. <http://www.sciencemag.org/content/339/6124/1207>

Brandstetter J, Reichholf JH (Hrsg.) (2017) Symbiosen. Das erstaunliche Miteinander in der Natur. Matthes und Seitz, Berlin, [ISBN 978-3-95757-366-7](https://www.matthesundseitz.de/ISBN-978-3-95757-366-7)

### **Nucleolus, Centrosome-Kinetosome, Undulipodia; Cytobones, Cytotubes, Sex**

Love R. (1966) Anisonucleolus in mammalian cell cultures. *Natl Canc Inst Monographs.* 23, 167–180.

Love R, Walsh RJ. (1968) Nucleolar morphology in normal diploid, neoplastic and aneuploid cells in vitro. *Cancer Res.* 30:990–997. [PubMed](https://pubmed.ncbi.nlm.nih.gov/10079781/)

Ugrinova I, Monier K, Ivaldi C, Thiry M, Storck S, Mongelard F, et al. (2007) Inactivation of nucleolin leads to nucleolar disruption, cell cycle arrest and defects in centrosome duplication. *BMC Mol Biol.* 8, 66. PMC free article [PubMed](https://pubmed.ncbi.nlm.nih.gov/17111111/)

Alliegro, MC, Satir P (2009) Origin of the Cilium: Novel approaches to examine a centriolar evolution hypothesis. *Meth. Cell Biol.* 94:51-63 <http://www.ncbi.nlm.nih.gov/pubmed/20362084>

Alliegro MC (2011) The centrosome and spindle as a ribonucleoprotein complex. *Chrom. Res.* 19, 367-376. <http://www.ncbi.nlm.nih.gov/pubmed/21287260>

Alliegro MC, Hartson S, Alliegro, MA. (2012) Composition and dynamics of the nucleolus, a physiological link between the nucleolus and cell division apparatus. *J. Biol. Chem.*

### **Self organization**

Bernard C (1859) *Leçons sur les propriétés physiologiques et les altérations pathologiques des liquides de l'organisme*. Paris, Librairie J.B. Baillière et fils.

Bernard C (1878) *Les phénomènes de la vie*. Paris, éditions Baillière.

Maxwell JK (1867/1868) On Governors. *Proceedings of the Royal Society of London.* 16, 270–283.



Canon WB (1926) Physiological regulation of normal states: some tentative postulates concerning biological homeostatics. Jubilee volume of Charles Richet. 91-3

[Wiener N](#) (1948) Cybernetics or Control and Communication in the Animal and the Machine. Hermann Editions, Paris

[Bertalanffy L von](#) (1948) Zu einer allgemeinen Systemlehre, Biologia Generalis. 195, MIT Press/Wiley & Sons, New York/Cambridge, S. 114–129

[Bertalanffy L von](#) (1957) Allgemeine Systemtheorie. Deutsche Universitätszeitung. 12, 8–12

[Bertalanffy L von](#) (1976) General System Theory. New York

Shannon CE, Weaver W (1949, 1998) The Mathematical Theory of Communication. Urbana and Chicago, University of Illinois Press.

[Ashby WR](#) (1956) Introduction to Cybernetics.

Wiener N (1961) Cybernetics or control and information in the animal and the machine, Massachusetts Institute of Technology.

Wiener N (1963). Kybernetik. Regelung und Nachrichtenübertragung im Lebewesen und in der Maschine, 2. revid. u. ergänzte Aufl., Econ, Düsseldorf.

Frohlich H (1968) Long Range Coherence and Energy Storage in Biological Systems. Int. J. Quantum Chem. v. II, 641-649 <http://garfield.library.upenn.edu/classics1988/A1988N102700001.pdf>

Frohlich H (1970) Long range coherence and the actions of enzymes. Nature 228, 1093. [https://www.researchgate.net/publication/51273814\\_Long\\_Range\\_Coherence\\_and\\_the\\_Action\\_of\\_Enzymes](https://www.researchgate.net/publication/51273814_Long_Range_Coherence_and_the_Action_of_Enzymes)

Frohlich H (1975) The extraordinary dielectric properties of biological materials and the action of enzymes. Proc Natl Acad Sci 72, 4211-4215.

Love R. (1966) Anisonucleolinos in mammalian cell cultures. Natl Canc Inst Monographs. 23, 167–180.

Love R, Walsh RJ. (1968) Nucleolar morphology in normal diploid, neoplastic and aneuploid cells in vitro. Cancer Res. 30:990–997. [PubMed](#)

Clynes M (1969) Cybernetic Implications of Rein Control in Perceptual and Conceptual Organization. Ann. N.Y. Acad. Sci. 156, 629-70

King JL, Jukes TH (1969) Non-Darwinian Evolution. Science 164, S. 788 ff.

Merril CR et al. (1971) Bacterial virus gene expression in human cells. Nature 233, 398-400.

Röhler R (1973) Biologische Kybernetik. Stuttgart, B.G. Teubner.

Tilley R, Tilley J (1974) Superfluidity and Superconductivity, Halsted Press

<http://www.amazon.com/Superfluidity-Superconductivity-Graduate-Student-Physics/dp/0750300337>

Sachsse H (1974). Einführung in die Kybernetik, Vieweg, Braunschweig.

Stapp H (1977) Are Superluminal Connections Necessary? I1 Nuovo Cimento, 40B(1), 191-204 <http://link.springer.com/article/10.1007%2FBF02739191#page-1>

Wu TM, Austin S (1977) Bose condensation in biosystems. Phys Lett A 64,151–152 [https://www.researchgate.net/publication/232354186\\_Bose\\_condensation\\_in\\_biosystems](https://www.researchgate.net/publication/232354186_Bose_condensation_in_biosystems)

Wu TM, Austin S (1978) Cooperative behavior in biological systems. Phys Lett A 65, 74–76 [https://www.researchgate.net/publication/256583304\\_Cooperative\\_behavior\\_in\\_biological\\_systems?el=1\\_x\\_8&enrichId=rgreq-2924435510ef399df1b6111b2fe848c3-XXX&enrichSource=Y292ZXJQYWdlOzI3OTUzNDIzNTtBUzoyNDY5OTA0NDU0Nzc4ODhAMTQzNTg5ODUxOTI3Ng==](https://www.researchgate.net/publication/256583304_Cooperative_behavior_in_biological_systems?el=1_x_8&enrichId=rgreq-2924435510ef399df1b6111b2fe848c3-XXX&enrichSource=Y292ZXJQYWdlOzI3OTUzNDIzNTtBUzoyNDY5OTA0NDU0Nzc4ODhAMTQzNTg5ODUxOTI3Ng==)

Wu TM, Austin S (1981) Froehlich's model of bose condensation in biological systems. J Biol Phys 9, 97–107 [https://www.researchgate.net/publication/226919399\\_Frohlich's\\_model\\_of\\_bose\\_condensation\\_in\\_biological\\_systems?el=1\\_x\\_8&enrichId=rgreq-2924435510ef399df1b6111b2fe848c3-XXX&enrichSource=Y292ZXJQYWdlOzI3OTUzNDIzNTtBUzoyNDY5OTA0NDU0Nzc4ODhAMTQzNTg5ODUxOTI3Ng](https://www.researchgate.net/publication/226919399_Frohlich's_model_of_bose_condensation_in_biological_systems?el=1_x_8&enrichId=rgreq-2924435510ef399df1b6111b2fe848c3-XXX&enrichSource=Y292ZXJQYWdlOzI3OTUzNDIzNTtBUzoyNDY5OTA0NDU0Nzc4ODhAMTQzNTg5ODUxOTI3Ng)

Cruse H (1981) Biologische Kybernetik. Weinheim, Deerfield Beach (Fl.), Basel Verlag Chemie.

Thompson NS (1981) Toward a falsifiable Theory of Evolution. Perspectives of Ethology 4 [http://www2.clarku.edu/faculty/nthompson/1-websitestuff/Texts/1980-1984/Toward\\_a\\_falsifiable\\_theory\\_of\\_evolution.pdf](http://www2.clarku.edu/faculty/nthompson/1-websitestuff/Texts/1980-1984/Toward_a_falsifiable_theory_of_evolution.pdf) [http://link.springer.com/chapter/10.1007%2F978-1-4615-7575-7\\_3#page-1](http://link.springer.com/chapter/10.1007%2F978-1-4615-7575-7_3#page-1)

Sonea S., Panisset M. (1983) A New Bacteriology. Jones and Barlett Publishers, Inc. Boston ISBN 0-86720-024-3

Kimura M (1983) The Neutral Theory of Molecular Evolution. Cambridge University Press <http://www.nature.com/scitable/topicpage/Neutral-Theory-The-Null-Hypothesis-of-Molecular-839>

Luhmann N (1984, 2001) Soziale Systeme. Grundriß einer allgemeinen Theorie, Frankfurt am Main 1984, neue Auflage 2001, [ISBN 3518282662](#)

An der Heiden U, Roth G, Schwegler H (1985) Die Organisation der Organismen: Selbsterstellung und Selbsterhaltung. Funktionelle Biologie und Medizin. 5, 330-346

Roth G (1986) Selbstorganisation – Selbsterhaltung – Selbstreferentialität: Prinzipien der Organisation der Lebewesen und ihre Folgen für die Beziehung zwischen Organismus und Umwelt. In: Dress A, Heinrichs H, Küppers G (Hg.) Selbstorganisation – zur Bedeutung eines neuen disziplinübergreifenden Paradigmas für die Einzelwissenschaften, Piper, München

Görnitz T (1988) [Abstract Quantum Theory and Space-Time Structure: I. Ur Theory and Bekenstein-Hawking](#)

[Entropy](https://www.researchgate.net/publication/225853984) International Journal of Theoretical Physics 27/5, 527-542.  
<https://www.researchgate.net/publication/225853984> Abstract quantum theory and space-time structure I Ur theory and Bekenstein-Hawking entropy

„Protyposis (griech.: προτύπωση, das Vorbilden) ist ein von dem Physiker [Thomas Görnitz](https://de.wikipedia.org/wiki/Protyposis) geprägter Begriff für eine abstrakte [Quanteninformation](https://de.wikipedia.org/wiki/Protyposis)“. S.a.: <https://de.wikipedia.org/wiki/Protyposis>

Simon R, Smith A (1988) Superconductors - Conquering Technology's New Frontier, Plenum Press.  
<http://www.amazon.com/Superconductors-Conquering-Technology's-New-Frontier/dp/0306429594>

Marshall IN (1989) Consciousness and Bose-Einstein Condensates. New Ideas in Psychology, v.7, n.1  
<http://www.sciencedirect.com/science/article/pii/0732118X8990038X>

Zohar D (1990) The Quantum Self, William Morrow and Company  
<http://www.amazon.com/The-Quantum-Self-Danah-Zohar/dp/0688107362>

Lewin R. (1992) Die Komplexitäts-Theorie. Wissenschaft nach der Chaos-Forschung. Hoffmann und Campe. ISBN 3-455-08537-7

Silverman M (1993) And Yet it Moves... Strange systems and subtle questions in physics, Cambridge  
<http://www.amazon.com/dp/0521446317>

Stapp H (1993) Mind, Matter, and Quantum Mechanics, Springer-Verlag  
<http://www.amazon.de/Matter-Quantum-Mechanics-Frontiers-Collection/dp/3540896538>

Omnes R (1994) The Interpretation of Quantum Mechanics, Princeton  
<http://www.amazon.com/Interpretation-Quantum-Mechanics-Roland-Omn%C3%A8s/dp/0691036691>

Penrose R (1994) Shadows of the Mind, Oxford University Press  
<http://www.amazon.de/Shadows-Mind-Missing-Science-Consciousness/dp/0195106466>

Kauffman S. (1996) Self-replication. Even peptides do it. Nature. 382(6591), 496-497

Lee DH. et al. (1996) A self-replicating peptide. Nature, 382(6591), 525-528

't Hooft G (1997) In Search of the Ultimate Building Blocks, Cambridge  
<http://www.amazon.com/In-Search-Ultimate-Building-Blocks/dp/0521578833>

Margulis L. (1997) Microcosmos four billion years of microbial evolution. University of California Press Berkeley, Los Angeles, London ISBN 0-520-21064-6  
<http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mcb.section.2187>

Cramer F. (1998) Symphonie des Lebendigen. Versuch einer allgemeinen Resonanztheorie. Insel Verlag.  
<http://www.amazon.de/Symphonie-Lebendigen-Versuch-allgemeinen-Resonanztheorie/dp/3458338888>

Matzinger P. (1998) An innate sense of danger. Immunology 10, 399-415, Article No. Si980143

Dietrich JW (2000) Signal Storage in Metabolic Pathways: The ASIA Element. Kyberneticnet 1 2,2000), 1-9

Chapman MJ, Dolan MF, Margulis L. (2000) Centrioles and Kinetosomes: Form, Function, and Evolution. The Quart.Rev.of Biology Vol 75, No.4

Moran NA, Baumann P (2000) Bacterial endosymbionts in animals. Curr Opin. Microbiol. 3, 270-75

Salzberg SL et al. (2001) Microbial Genes in the Human Genome: Lateral Transfer or Gene Loss? Science, June 8. <http://www.the-scientist.com/news/display/53552/#ixzz1CMStkOjf>

Tamas I. et al., (2002) [50 million years of genomic stasis in endosymbiotic bacteria](http://www.the-scientist.com/news/display/53552/#ixzz1CMStkOjf) Science, 296(5577), 2376-9.

Timmis JN, Ayliffe MA, Huang CY, Martin W. (2004) Endosymbiotic gene transfer: organelle genomes forge eukaryotic chromosomes. Nat.Rev.Genet. 5, 123-135

Douglas AR, Raven JA (2003) Genomes at the interface between bacteria and organelles. Phil. Trans. R. Soc. Lond B 358 , 5-18

Okamoto N, Inouye I, (2005) [A secondary symbiosis in progress?](http://www.the-scientist.com/news/display/53552/#ixzz1CMStkOjf) Science, 310(5746), 287

Choi CQ (2007) Bacterial genes jump to host. Frequent lateral gene transfer from bacteria to their host organisms may be a mechanism for hosts' evolution. The Scientist 03:57 PM GMT <http://www.the-scientist.com/news/display/53552/#ixzz1CMStkOjf>

Huisman BD (2007) Lebendigkeit – Selbstorganisation – Morphogenese: 5. Hauptsatz der Thermodynamik, das Phanes Sound Theorem. Grin Verlag, ISBN 978-3-638-77985-2  
<http://www.grin.com/de/e-book/71284/lebendigkeit-selbstorganisation-morphogenese-5-hauptsatz-der-thermodynamik>

Dunning Hotopp JC et al., (2007) Widespread Lateral Gene Transfer from Intracellular Bacteria to Multicellular Eukaryotes. Science. <http://www.the-scientist.com/news/display/53552/#ixzz1CMQmPXcy>

Ugrinova I, Monier K, Ivaldi C, Thiry M, Storck S, Mongelard F, et al. (2007) Inactivation of nucleolin leads to nucleolar disruption, cell cycle arrest and defects in centrosome duplication. BMC Mol Biol. 8, 66. [PMC free article PubMed](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1444441/)

Brizhik LS, Del Giudice E, Maric-Oehler W, Popp FA, Schlebusch KP (2009) On the dynamics of self-organization in living organisms. Electromagn. Biology and Medicine. 28(1), 28-40; DOI: 10.1080/15368370802708272  
<https://www.researchgate.net/publication/24249635> On the Dynamics of Self-Organization in Living Organisms

Oriol Romero-Isart et al. (2010) Toward quantum superposition of living organisms. New Journal of Physics, 12, 033015 <http://iopscience.iop.org/1367-2630/12/3/033015/>



Seckbach J. et al. (2010) Symbioses and Stress: Joint Ventures in Biology. <http://www.amazon.de/gp/search?index=books&linkCode=qs&keywords=9048194482>

Alliegro MA, Henry JJ, Alliegro MC. (2010) Rediscovery of the nucleolinus, a dynamic RNA-rich organelle associated with the nucleolus, spindle and centrosomes. *Proc Natl Acad Sci USA*. 107, 13718–13723. [PMC free article PubMed](https://pubmed.ncbi.nlm.nih.gov/19811111/) <http://www.pnas.org/content/107/31/13718.full.pdf+html>

Alliegro MC (2011) The Nucleolinus. A disappearing, forgotten and (maybe) misnamed organelle. *Commun Integr Biol*. 4(2), 147–149. doi: [10.4161/cib.4.2.14545](https://doi.org/10.4161/cib.4.2.14545) PMID: PMC3104566 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3104566/>

Alliegro MC, Hartson S, Alliegro MA (2012) Composition and dynamics of the nucleolinus, a link between the nucleolus and cell division apparatus in surf clam (*Spisula*) oocytes. *The Journal of Biological Chemistry*. 287(9), 6702-13. <http://www.ncbi.nlm.nih.gov/pubmed/22219192>

Pribram K (2010, 2012) The Holographic Brain (excerpt) - A Thinking Allowed DVD with Dr. Jeffrey Mishlove. <https://www.youtube.com/watch?v=vHpTYs6GJhQ> <https://www.youtube.com/watch?v=awFleswtH2Y>

van Leunen H (2011) A Tall Quantum Tale. 793.23 KB [Download](#)

van Leunen H (2017) Hilbert Book Model Project. [https://en.wikiversity.org/wiki/Hilbert\\_Book\\_Model\\_Project](https://en.wikiversity.org/wiki/Hilbert_Book_Model_Project)

Plankar M, Jerman I, Krasovec R (2011) Review On the origin of cancer: Can we ignore coherence? BION Institute, Stegne 21, 1000 Ljubljana, Slovenia [https://www.researchgate.net/publication/236006055\\_On\\_the\\_origin\\_of\\_cancer\\_Can\\_we\\_ignore\\_coherence](https://www.researchgate.net/publication/236006055_On_the_origin_of_cancer_Can_we_ignore_coherence)

« However, it has only recently gained major scientific interest when it was measured on photosynthetic complexes at physiological temperatures and confirmed to have a direct effect over the dynamics of the energy transfer. Several theoretical and experimental considerations suggest that cancer might be associated with the absence or impairment of the proper coherent dynamics in certain biological structures, most notably in the microtubules. »

King Chr. (2011) Cosmological Foundations of Consciousness. *Journal of Cosmology*, 14. <http://journalofcosmology.com/Consciousness103.html> [https://www.researchgate.net/publication/277257636\\_Cosmological\\_Foundations\\_of\\_Consciousness](https://www.researchgate.net/publication/277257636_Cosmological_Foundations_of_Consciousness)

Margulis M. (2011) Chimeras and Consciousness: Evolution of the Sensory Self. ISBN-10: 0262515830 ISBN-13: 978-0262515832

Wu J, Weening EH, Faske JB et al. (2011) Invasion of Eukaryotic Cells by *Borrelia burgdorferi* Requires Integrins and Src Kinase Activity. *Infection and Immunity*, 1338–1348

Pereira C (2015) Quantum Consciousness in Animals. *Journal of Metaphysics and Connected Consciousness* (August 2015)

Meijer DKF (2012) The Information Universe. On the Missing Link in Concepts on the Architecture of Reality. *Syntropy Journal* 1, 1-64. <http://www.sintropia.it/english/2012-eng-1-1.pdf>

Meijer DKF, Geesink JH, (2016) Phonon Guided Biology. Architecture of Life and Conscious Perception are mediated by Toroidal Coupling of Phonon, Photon and Electron Information Fluxes at Discrete Eigenfrequencies. *Neuro Quantology*, 14, 718-755.

Meijer DKF, Geesink JH, (2017) Consciousness in the Universe is Scale Invariant and Implies the Event horizon of the Human Brain. *Neuro Quantology*, 15, 41-79.

Meijer DKF, Geesink JH, (2018) Favourable and Unfavourable EMF Frequency Patterns in Cancer: Perspectives for Improved Therapy and Prevention. *J. Cancer Therapy*, 9, 188-230

Shifman M (2012) *Advanced Topics in Quantum Field Theory: A Lecture Course*. Cambridge University Press <http://www.amazon.com/Advanced-Topics-Quantum-Field-Theory/dp/0521190843>

Zalta EN, Nodelman U, Alken C et al. (2016) The Uncertainty Principle. *Stanford Encyclopedia of philosophy*. <https://leibniz.stanford.edu/friends/preview/qt-uncertainty/>

Jerman I (2016) The Origin of Life from Quantum Vacuum, Water and Polar Molecules. *American Journal of Modern Physics*. Special Issue: Academic Research for Multidisciplinary. Vol. 5, No. 4-1, 2016, pp. 34-43. doi: 10.11648/j.ajmp.s.2016050401.16 <http://article.sciencepublishinggroup.com/html/10.11648.j.ajmp.s.2016050401.16.html>

Geesink JH, Meijer DKF, (2017) Electromagnetic Frequency Patterns that are Crucial for Health and Disease Reveal a Generalized Biophysical Principle: the GM scale. *Quantum Biosystems*, 8, 1-16.

Geesink JH, Meijer DKF, (2018) Mathematical Structure of the GM Life Algorithm that May Reflect Bohm's Implicate Order. *J. Modern Physics*, 9, 851- 897

Geesink JH, Meijer DKF, (2018) A semi-harmonic electromagnetic frequency pattern organizes non-local states and quantum entanglement in both EPR studies and life systems. *J. Modern Physics*, 9, 898-924

Geesink JH, Meijer DKF (2018) Semi-Harmonic Scaling enables Calculation of Masses of Elementary Particles of the Standard Model. *J. Modern Physics*, 9, 925-947

Geesink HJH, Meijer DKF (2018) Evidence for a Guiding Coherence Principle in Quantum Physics. *Projects The Information Universe. On the Missing Link in Concepts on the Architecture of Reality*. [https://www.researchgate.net/publication/325013224\\_Evidence\\_for\\_a\\_Guiding\\_Coherence\\_Principle\\_in\\_Quantum\\_Physics/comments?focusedCommentId=5af9c0fab53d2f63c3cbc063](https://www.researchgate.net/publication/325013224_Evidence_for_a_Guiding_Coherence_Principle_in_Quantum_Physics/comments?focusedCommentId=5af9c0fab53d2f63c3cbc063)

## Pattern matching

Campbell DT (1966) Pattern matching as an essential of distal knowing. New York: Holt, Rinehard & Winston, in K.R. Hammond (ed.) The Psychology of Egon Brunswik 81-106 (Reprinted in Kornblith, Naturalizing Epistemology)

Lorenz K. (1973) Die Rückseite des Spiegels. Piper.

Trochim WMK (1985) Pattern matching, Validity, and Conceptuation in Program Evaluation. Evaluation Review 9(5), 575-604

Matzinger P. (1998) An innate sense of danger. Immunology 10,399-415, Article No. Si980143

Matzinger P. (2001) The Danger Model: A Renewed Sense of Self. <http://www.direct-ms.org/pdf/ImmunologyGeneral/DangerModel.pdf>

Matzinger P. (2002) The Danger Model: A Renewed Sense of Self. Science 296(5566) 301-305 <http://www.sciencemag.org/content/suppl/2002/04/11/296.5566.301.DC1>

Gibson W. (2005) Pattern Recognition

<http://www.amazon.com/Pattern-Recognition-William-Gibson/dp/0425198685>

Meylan E et al. (2006) Intracellular pattern recognition receptors in the host response. Nature. 442(7098), 39–44. <http://www.ncbi.nlm.nih.gov/pubmed/16823444?dopt=Abstract>

Huismans BD (2007) Nullquantum Zahlensymbolik und Struktur. Grin Verlag, ISBN 978-3-638-87371-0 <http://www.grin.com/de/e-book/80450/nullquantum-zahlensymbolik-und-struktur>

BlanderJM, Sander LE (2012) Opinion: Beyond pattern recognition: five immune checkpoints for scaling the microbial threat. Nature Reviews Immunology 12, 215-225 doi:10.1038/nri3167

<http://www.nature.com/nri/journal/v12/n3/abs/nri3167.html>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.11 Anamnesis, physical examination, pathogens, antibiotics, costs**

Huismans BD (2009) Formularsammlung und Diskussionsbeitrag zu Diagnostik und Therapie bei Patienten mit chronischer Lyme-Borreliose und Koinfektionen. Grin Verlag

<http://www.grin.com/de/e-book/122218/formularsammlung-unddiskussionsbeitrag-zu-diagnostik-und-therapie-bei>

Huismans BD (2014) Warum Borrelien infektiös bleiben trotz intensiver antibiotischer Behandlung

<http://www.xerlebnishaft.de/escape.pdf> [http://www.xerlebnishaft.de/escape\\_eng.pdf](http://www.xerlebnishaft.de/escape_eng.pdf)

Tokarz R, Tagliafierro T, Sameroff S et al. (2019) Microbiome analysis of Ixodes scapularis ticks from New York and Connecticut. *Ticks Tick Borne Dis.* pii: S1877-959X(19)30033-0. doi:10.1016/j.ttbdis.2019.04.011.

<https://www.ncbi.nlm.nih.gov/pubmed/31023629>

«We employed high throughput sequencing to survey the microbiomes of Ixodes scapularis collected in New York and Connecticut. We examined 197 individual I. scapularis adults and pools from 132 adults and 197 nymphs. We detected Borrelia burgdorferi sensu stricto in 56.3% of individual ticks, Anaplasma phagocytophilum in 10.6%, Borrelia miyamotoi in 5%, Babesia microti in 7.6%, and Powassan virus in 3.6%. We did not detect Borrelia mayonii, Ehrlichia muris euclairensis, Bartonella spp. or pathogenic Babesia species other than B. microti. The most abundant bacterium (65%), and only rickettsial species identified, was the endosymbiont Rickettsia buchneri. A filarial nematode was found in 13.7% of adult ticks. Fourteen viruses were detected including South Bay virus (22%) and blacklegged tick phlebovirus 1 and 2 (73%). This study provides insight into the microbial diversity of I. scapularis in New York State and Connecticut».

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## 2.12 Cavete – Diagnoses

Huismans BD (2018) Diagnostik / Therapie und biologische Grundlagen zu Cavete-Diagnosen bei Multisystem-Krankheiten durch Krankheits-Erreger. GRIN Verlag ISBN: 9783668778511  
<https://www.grin.com/document/432181>

### Vegetative and psychosomatic diagnoses

#### 2.12.1 Fatigue without pain (CFS), Myalgic encephalomyelitis

##### Immunosystem

- Caligiuri M, Murray C, Buchwald D, Levine H, Cheney P, Peterson D, Komaroff AL, Ritz J (1987) Phenotypic and functional deficiency of natural killer cells in patients with chronic fatigue syndrome. *J Immunol.* 139(10), 3306-13 <https://www.ncbi.nlm.nih.gov/pubmed/2824604>
- Straus SE. (1988) The chronic mononucleosis syndrome. *J Infect Dis* 157, 405-12.
- Straus SE, Dale JK, Wright R, et al. (1988) Allergy and the chronic fatigue syndrome. *J Allergy Clin Immunol* 81,791-5
- Klimas NG, Salvato FR, Morgan R, et al. (1990) Immunologic abnormalities in chronic fatigue syndrome. *J Clin Microbiol* 28, 1403-10.
- Wakefield D, Lloyd A, Brockman A (1990) Immunoglobulin subclass abnormalities in patients with chronic fatigue syndrome. *Pediatr. Infect. Dis. J.* 9, S50–S53.
- Gupta S, Vayuvegula B (1991) A comprehensive immunological analysis in chronic fatigue syndrome. *Scand. J. Immunol.* 33, 319–327. 25.
- Landay AL, Jessop C, Lennette ET, Levy JA. (1991) Chronic fatigue syndrome: clinical condition associated with immune activation. *Lancet* 338, 707.
- Lad AR, Wakefield D, Hickie I (1993) Immunity and the pathophysiology of chronic fatigue syndrome. *Ciba Found. Symp.* 173, 176–192.
- Ojo-Amaize EA, Conley EJ, Peter JB. (1994) Decreased natural killer cell activity is associated with severity of chronic fatigue immune dysfunction syndrome. *Clin Infect Dis.* 18(1), 157-9.  
<https://www.researchednutritionals.com/store/item.cfm?code=CRN103&cat=3>
- Cannon JG, Angel JB, Ball RW, Abad LW, Fagioli L, et al. (1999) Acute phase responses and cytokine secretion in chronic fatigue syndrome. *J Clin Immunol* 19: 414–421.
- Patarca-Montero R, Antoni M, Fletcher MA, Klimas NG (2001) Cytokine and other immunologic markers in chronic fatigue syndrome and their relation to neuropsychological factors. *Appl Neuropsychol* 8, 51–64. doi: 10.1207/s15324826an0801\_7
- Zang, Z, Cherryholmes, G, Mao, A, Marek, C, Longmate J, Kalos, M, St Amand, RP, Shivley JE (2008) High plasma levels of MCP-1, and Eotaxin provide evidence for an immunological basis of Fibromyalgia. *J of Ex Bio Med* 233(9), 1171-80. doi: 10.3181/0712-RM-328. <http://www.ncbi.nlm.nih.gov/pubmed/18535166>  
« High levels of MCP-1 (P<0.001) and eotaxin (P<0.01) were found in patients and family members compared to controls. Patients (56/92) treated with the single agent guaifenesin (>3 months) had higher levels of eotaxin than those not treated (P<0.01). ... Furthermore, the chemokine profile associated with FMS has direct effects on the migration of eosinophils and monocytes in the presence of mast cells, and skeletal muscle itself may secrete»
- Feng J, Zhang Z, Li W, Shen X, Song W, et al. (2009) Missense Mutations in the MEFV Gene Are Associated with Fibromyalgia Syndrome and Correlate with Elevated IL-1b Plasma Levels. *PLoS ONE* 4(12): e8480. doi:10.1371/journal.pone.0008480
- Fletcher MA, et al. (2010) Biomarkers in chronic fatigue syndrome: evaluation of natural killer cell function and dipeptidyl peptidase IV/CD26. *PLoS One.* 5(5), e10817.
- Egger G (2012) In Search of a Germ Theory Equivalent for Chronic Disease. *Prev Chronic Dis* 9, 110301. DOI: <http://dx.doi.org/10.5888/pcd9.110301> [https://www.cdc.gov/pcd/issues/2012/11\\_0301.htm](https://www.cdc.gov/pcd/issues/2012/11_0301.htm)
- „The discovery of a form of low-grade systemic and chronic inflammation (“metaflammation”), linked to inducers (broadly termed “anthropogens”) associated with modern man-made environments and lifestyles, suggests an underlying basis for chronic disease that could provide a 21st-century equivalent of the germ theory.
- Die Entdeckung einer Form von niedrig gradiger systemischer und chronischer Entzündung ("Metaflammation"), die mit Induktoren (allgemein als "Anthropogene" bezeichnet) im Zusammenhang mit modernen vom Menschen geschaffenen Umgebungen und Lebensstilen in Verbindung gebracht wird, legt eine zugrunde liegende Basis für chronische Krankheiten nahe, als ein Äquivalent zur Keimtheorie des 21. Jahrhunderts“.
- Feng J, Zhang Z, Wu X, Mao A, Chang F, et al. (2013) Discovery of Potential New Gene Variants and Inflammatory Cytokine Associations with Fibromyalgia Syndrome by Whole Exome Sequencing. *PLoS ONE* 8(6), e65033. doi:10.1371/journal.pone.0065033
- [Vanelzakker MB](#) (2013) Chronic fatigue syndrome from vagus nerve infection: A psychoneuroimmunological hypothesis. *Med Hypotheses.* 81(3), 414-23. doi: 10.1016/j.mehy.2013.05.034. Epub 2013 Jun 19.

<http://www.ncbi.nlm.nih.gov/pubmed/23790471>

<http://dx.doi.org/10.1016/j.mehy.2013.05.034>

[http://www.medical-hypotheses.com/article/S0306-9877\(13\)00275-2/pdf](http://www.medical-hypotheses.com/article/S0306-9877(13)00275-2/pdf)

"According to this hypothesis, any pathogenic infection of the vagus nerve can cause CFS, which resolves the ongoing controversy about finding a single pathogen. The vagus nerve infection hypothesis offers testable hypotheses for researchers, animal models, and specific treatment strategies".

[Elfaitouri A](#), [Herrmann B](#), [Bölin-Wiener A](#), [Wang Y](#), [Gottfries CG](#), [Zachrisson O](#), [Pipkorn R](#), [Rönblom L](#), [Blomberg J](#). (2013) Epitopes of microbial and human heat shock protein 60 and their recognition in myalgic encephalomyelitis. *PLoS One*. 8(11), e81155 doi: 10.1371/journal.pone.0081155.

<http://www.ncbi.nlm.nih.gov/pubmed/24312270>

[Üçeyler N](#), [Zeller D](#), [Kahn AK](#), [Kewenig S](#) et al. (2013) Small fibre pathology in patients with fibromyalgia syndrome. *Brain*. 136(Pt 6), 1857-67. doi: 10.1093/brain/awt053. Epub 2013 Mar 9.

<http://www.ncbi.nlm.nih.gov/pubmed/23474848>

[Brenu EW](#) et al. (2013) Natural killer cells in patients with severe chronic fatigue syndrome. *Auto Immun Highlights* 4(3), 69–80.

[Naviaux RK](#) (2014) Metabolic features of the cell danger response. *Mitochondrion* 16, 7–17.

<http://www.ncbi.nlm.nih.gov/pubmed/23981537>

"The cell danger response (CDR) is the evolutionarily conserved metabolic response that protects cells and hosts from harm. ... An understanding of the CDR permits us to reframe old concepts of pathogenesis for a broad array of chronic, developmental, autoimmune, and degenerative disorders. These disorders include autism spectrum disorders (ASD), attention deficit hyperactivity disorder (ADHD), asthma, atopy, gluten and many other food and chemical sensitivity syndromes, emphysema, Tourette's syndrome, bipolar disorder, schizophrenia, post-traumatic stress disorder (PTSD), chronic traumatic encephalopathy (CTE), traumatic brain injury (TBI), epilepsy, suicidal ideation, organ transplant biology, diabetes, kidney, liver, and heart disease, cancer, Alzheimer and Parkinson disease, and autoimmune disorders like lupus, rheumatoid arthritis, multiple sclerosis, and primary sclerosing cholangitis".

[Hornig M](#), [Montoya JG](#), [Klimas NG](#) et al. (2015) Distinct plasma immune signatures in ME/CFS are present early in the course of illness. *Science Advances* 1(1), e1400121

DOI: 10.1126/sciadv.1400121 <http://advances.sciencemag.org/content/1/1/e1400121.full>

[Underhill RA](#) (2015) [Myalgic encephalomyelitis, chronic fatigue syndrome: An infectious disease](#). *Medical Hypotheses*, 85(6), 765-773 Open Access

[http://www.medical-hypotheses.com/article/S0306-9877\(15\)00382-5/fulltext](http://www.medical-hypotheses.com/article/S0306-9877(15)00382-5/fulltext)

[Saury JM](#) (2016) [The role of the hippocampus in the pathogenesis of Myalgic Encephalomyelitis/Chronic Fatigue Syndrome \(ME/CFS\)](#) *Medical Hypotheses*, 86, 30-38

[http://www.medical-hypotheses.com/article/S0306-9877\(15\)00447-8/fulltext](http://www.medical-hypotheses.com/article/S0306-9877(15)00447-8/fulltext)

[Nguyen T](#), [Johnston S](#), [L. Clarke L](#) (2017) Impaired calcium mobilization in natural killer cells from chronic fatigue syndrome/myalgic encephalomyelitis patients is associated with transient receptor potential melastatin 3 ion channels. *Clin Exp Immunol*. 187(2), 284–293. Published online 2016 Nov 23. doi:10.1111/cei.12882

PMCID: PMC5217865 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5217865/>

[Montoya JG](#), [Holmes TH](#), [Anderson JN](#) et al. (2017) Cytokine signature associated with disease severity in chronic fatigue syndrome patients. doi: 10.1073/pnas.1710519114

<http://www.pnas.org/content/early/2017/07/25/1710519114.full4>

„Although only two cytokines were found to be different (TGF- $\beta$  higher and resistin lower) in ME/CFS patients compared with controls, 17 cytokines correlated with ME/CFS severity. Thirteen of these cytokines are proinflammatory and may contribute to many of the symptoms these patients experience for several years. Only CXCL9 (MIG) inversely correlated with fatigue duration.“

[Hotamisligil GS](#) (2017) Inflammation, metaflammation and immunometabolic disorders. *Nature*. 542(7640), 177-185. doi: 10.1038/nature21363. <https://www.ncbi.nlm.nih.gov/pubmed/28179656>

## Viruses

[Buchwald D](#), [Goldenberg DL](#), [Sullivan JL](#), et al. (1987) The "chronic, active Epstein-Barr virus infection" syndrome and primary fibromyalgia. *Arthritis Rheum* 30, 1132-6.

[Gurvis S](#) (1987) Epstein-Barr: Myth and Reality. *The Spokesman-Review* 23. Nov. 1987.

[Behan PO](#), [Behan WMH](#). (1988) Postviral fatigue syndrome. *Crit Rev Neurobiol* 4, 157-78.

[Dowsett, EG](#) et al. (1990) Myalgic encephalomyelitis – a persistent enteroviral infection? *Postgraduate Medical Journal*, 66, 526-30

[Wessely S](#). (1991) Viruses and fatigue: the current status of chronic fatigue syndrome. In: [Kurstak E](#), ed. *Psychiatry and biological factors*. New York, NY: Plenum Press, 231-56.

[Miller NA](#), [Carmichael HA](#), [Calder BD](#), et al. (1991) Antibody to coxsackie B virus in diagnosing postviral fatigue syndrome. *BMJ* 302, 140-3.

[DeFreitas E](#), [Cheney PR](#), [Koprowski H](#) et al. (1991) Retroviral sequences related to human T-lymphotropic virus type II in patients with chronic fatigue immune dysfunction syndrome (Epstein-Barr virus syndrome/ infectious mononucleosis/ myalgic encephalomyelitis/ polymerase chain reaction/ in situ hybridization)", *Proc. Natl. Acad. Sci. USA*



Holmes MJ (1992) A Retrovirus Aetiology for CFS? Chapter 33 (S. 319-324) in Hyde BM (H. & A.), Levine PH (H.), Goldstein JA (H. & A.), „The Clinical and Scientific Basis for M.E./ CFS“, Nightingale Research Foundation (C. A.) 1992

[Buchwald D](#), [Cheney PR](#), [Peterson DL](#), [Henry B](#), [Wormsley SB](#), [Geiger A](#), [Ablashi DV](#), [Salahuddin SZ](#), [Saxinger C](#), [Biddle R](#) et al. (1992) A chronic illness characterized by fatigue, neurologic and immunologic disorders, and active human herpesvirus type 6 infection. [Ann Intern Med.](#) 116,103

Hay J, Jenkins F (1994) Human herpesviruses and chronic fatigue syndrome. In: Straus S, ed. Chronic fatigue syndrome. New York, NY: Marcel Dekker, 181-98.

Gow JW, Behan WM, Simpson K, et al. (1994) Studies of enteroviruses in patients with chronic fatigue syndrome. Clin Infect Dis 18(suppl I), 126-9.

Swanink CMA, Melchers WJG, van der Meer JWM, et al. (1994) Enteroviruses and the chronic fatigue syndrome. Clin Infect Dis 19, 860-4.

White P, Thomas J, Amess J, et al. (1994) A fatigue syndrome following infectious mononucleosis. I. The existence of the syndrome. Psychol Med Strober W. Immunological function in chronic fatigue syndrome. In: Straus S, ed. Chronic fatigue syndrome. New York, NY: Marcel Dekker, 207-40.

Glaser R, Padgett DA, Litsky ML, Baiocchi RA, Yang EV, et al. (2005) Stress-associated changes in the steady-state expression of latent Epstein-Barr virus: implications for chronic fatigue syndrome and cancer. Brain Behav Immun 19, 91–103. doi: 10.1016/j.bbi.2004.09.001

Hickie I, Davenport T, Wakefield D, Vollmer-Conna U, Cameron B, et al. (2006) Post-infective and chronic fatigue syndromes precipitated by viral and non-viral pathogens: prospective cohort study. BMJ 333, 575. doi: 10.1136/bmj.38933.585764.ae

Singh IR, Gorzynski JE, Drobysheva D, Bassit L, Schinazi RF (2010) Raltegravir Is a Potent Inhibitor of XMRV, a Virus Implicated in Prostate Cancer and Chronic Fatigue Syndrome. PLoS One

Mikovits JA et al. (2011) Xenotropic Murine Leukemia Virus-related Virus-associated Chronic Fatigue Syndrome Reveals a Distinct Inflammatory Signature, In Vivo 2011

Enksen W (2017) [The spread of EBV to ectopic lymphoid aggregates may be the final common pathway in the pathogenesis of ME/CFS](#) Medical Hypotheses, Vol. 102, 8-15

[http://www.medical-hypotheses.com/article/S0306-9877\(16\)30867-2/fulltext](http://www.medical-hypotheses.com/article/S0306-9877(16)30867-2/fulltext)

Feiring B et al. (2017) HPV vaccination and risk of chronic fatigue syndrome/myalgic encephalomyelitis: A nationwide register-based study from Norway, Vaccine,

[https://ars.els-cdn.com/content/image/1-s2.0-S024410X17308083-gr1\\_lrg.jpg](https://ars.els-cdn.com/content/image/1-s2.0-S024410X17308083-gr1_lrg.jpg)

#### **Bacteria and misfolded Proteins**

Shor S (2011) RETROSPECTIVE ANALYSIS OF A COHORT OF INTERNATIONALLY CASE DEFINED CHRONIC FATIGUE SYNDROME PATIENTS IN A LYME ENDEMIC ARE. Bulletin of the IACFS/M E. 18(4), 109 - 123.© 2011 IACFS/ME

<http://www.iacfsme.org/LinkClick.aspx?fileticket=VcL5jCgZHa8%3D&tabid=458>

Donta ST (2014) Lyme Disease, Chronic Fatigue and Fibromyalgia. Chronic Dis Int. 1(1), 2.

[Institute of Medicine \(Hg.\): Report Beyond Myalgic Encephalomyelitis/Chronic Fatigue Syndrome: Redefining an Illness; 10. Februar 2015](#)

<http://www.iom.edu/Reports/2015/ME-CFS.aspx>

[Patrick DM](#), [Miller RR](#), [Gardy JL](#) et al. (2015) Lyme Disease Diagnosed by Alternative Methods: A Common Phenotype with Chronic Fatigue Syndrome. Clin Infect Dis. doi: 10.1093/cid/civ470

<http://cid.oxfordjournals.org/content/early/2015/06/16/cid.civ470.abstract>

#### **Toxins**

Hilgers A, Johannes Frank J (1994) Chronic Fatigue Syndrom: Immundysfunktion, Erreger- und Schadstoffbeteiligung sowie neurologische und kardiale Veränderungen, Wien Med Wschr 16, 399-406 [PMID 7856214](#) <http://www.ncbi.nlm.nih.gov/pubmed/7856214?dopt=Abstract>

[Stejskal V](#), [Ockert K](#), [Bjørklund G](#) (2013) Metal-induced inflammation triggers fibromyalgia in metal-allergic patients. [Neuro Endocrinol Lett.](#) 34(6), 559-65. <https://www.ncbi.nlm.nih.gov/pubmed/24378456>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **Dermatological Diagnoses**

## 2.12.2 Morgellons disease

### Bacteria and misfolded Proteins

Raymond CJ (1988) A case of septicaemia caused by *Agrobacterium radiobacter*. *Journal of Infection*. 16 (2), 205–6. PMID 3351321. doi:10.1016/s0163-4453(88)94272-7.

[http://www.journalofinfection.com/article/S0163-4453\(88\)94272-7/abstract](http://www.journalofinfection.com/article/S0163-4453(88)94272-7/abstract)

Read DH, Walker RL, Castro AE, Sundberg JP, Thurmond JC, et al. (1992) An invasive spirochaete associated with interdigital papillomatosis of dairy cattle. *Vet Rec*. 130, 59–60.

Dunne Jr WM, Tillman J, Murray JC (1993) Recovery of a strain of *Agrobacterium radiobacter* with a mucoid phenotype from an immunocompromised child with bacteremia. *Journal of clinical microbiology*. 31 (9), 2541–3. PMC 265809. PMID 8408587. <http://jcm.asm.org/content/31/9/2541.abstract>

Grund S, Nattermann H, Horsch F. (1995) Zum elektronenmikroskopischen Spirochäten-Nachweis bei der Dermatitis digitalis des Rindes. *Journal of Veterinary Medicine, Series B* 42, (1-10), 533–542, Article first published online: 13 MAY 2010

<http://onlinelibrary.wiley.com/doi/10.1111/j.1439-0450.1995.tb00745.x/abstract>

„Eine antigene Verwandtschaft zu *Borrelia burgdorferi*, zumindest im Bereich von Geißeln und undulierender Membran zeigt sich bei der Immunelektronenmikroskopie.

An antigenic relationship to *Borrelia burgdorferi*, at least in the range of flagella and Undulating membrane appears in the immune electron microscopy."

Borgmann IE, Bailey J, Clark EG (1996) Spirochete-associated bovine digital dermatitis. *Can Vet J*. 37(1): 35–37. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1576595/>

Döpfer D, Koopmans A, Meijer FA, Szaskall I, Schukken WH, Klee W, et al. (1997) Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis*. *Vet Rec*. 140, 620–3.

CHOI BK, NATTERMANN H, GRUND S et al. (1997) Spirochetes from Digital Dermatitis Lesions in Cattle Are Closely Related to Treponemes Associated with Human Periodontitis. *Int J Syst Bacteriol* 47 175-181; DOI 10.1099/00207713-47-1-175

Stricker RB et al. (2007) Contribution Of *agrobacterium* to Morgellons Disease. *Journal of Investigative Medicine* 278, 55.1, S123.

[http://www.researchgate.net/publication/232120571\\_Contribution\\_of\\_Agrobacterium\\_to\\_Morgellons\\_Disease\\_287](http://www.researchgate.net/publication/232120571_Contribution_of_Agrobacterium_to_Morgellons_Disease_287)

Middelveen MJ, Stricker RB (2011) Filament formation associated with spirochetal infection: a comparative approach to Morgellons disease. *Clin Cosmet Investig Dermatol*. 4, 167–177. doi: 10.2147/CCID.S26183

PMCID: PMC3257881 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3257881/>

Middelveen MJ, Burugu D, Poruri A et al. (2013) Association of spirochetal infection with Morgellons disease [v1; ref status: indexed, <http://f1000r.es/8g>] *F1000Research* 2, 25, doi:10.12688/f1000research.2-25.v1. ISSN 2046 - 1402. <http://f1000research.com/articles/2-25/v1>

<http://www.ncbi.nlm.nih.gov/pubmed/24715950>

[http://cdn.f1000r.com.s3.amazonaws.com/manuscripts/304/83405a39-48a5-4689-9a81-7e3aeaa76fee\\_raphael%20stricker.pdf](http://cdn.f1000r.com.s3.amazonaws.com/manuscripts/304/83405a39-48a5-4689-9a81-7e3aeaa76fee_raphael%20stricker.pdf)

"Based on histological staining, immunofluorescent staining, electron microscopic imaging and polymerase chain reaction, we report the detection of *Borrelia* spirochetes in dermatological tissue of four randomly-selected MD patients. The association of MD with spirochetal infection provides evidence that this infection may be a significant factor in the illness and refutes claims that MD lesions are self-inflicted and that people suffering from this disorder are delusional. Molecular characterization of the *Borrelia* spirochetes found in MD patients is warranted".

Middelveen MJ, Bandoski Ch, Burke J et al. (2015) Exploring the association between Morgellons disease and Lyme disease: identification of *Borrelia burgdorferi* in Morgellons disease patients. *BioMed Central Dermatology* 15(1) doi:10.1186/s12895-015-0023-0. ISSN 1471-5945.

<http://www.biomedcentral.com/1471-5945/15/1/abstract>

<http://www.biomedcentral.com/content/pdf/s12895-015-0023-0.pdf>

<http://bmcdematol.biomedcentral.com/articles/10.1186/s12895-015-0023-0>

Middelveen MJ, Stricker RB (2016) Morgellons disease: a filamentous borrelial dermatitis. *International Journal of General Medicine* » Volume 9 DOI <https://dx.doi.org/10.2147/IJGM.S116608>

<https://www.dovepress.com/morgellons-disease-a-filamentous-borrelial-dermatitis-peer-reviewed-fulltext-article-IJGM>

Middelveen MJ, Rotaru GM, McMurray JL, Filush KR, Sapi E, et al. (2016) Canine Filamentous Dermatitis Associated with *Borrelia* Infection. *J Vet Sci Med Diagn* 5, 6. doi: 10.4172/2325-9590.1000217

[http://www.scitechnol.com/peer-review/canine-filamentous-dermatitis-associated-with-borrelia-infection-1Qxf.php?article\\_id=5548](http://www.scitechnol.com/peer-review/canine-filamentous-dermatitis-associated-with-borrelia-infection-1Qxf.php?article_id=5548)

Middelveen MJ, Sapi E, Burke J et al. (2018) Persistent *Borrelia* Infection in Patients with Ongoing Symptoms of Lyme Disease. *Healthcare (Basel)*. 6(2), 33. Published online 2018 Apr 14.

doi: [10.3390/healthcare6020033](https://doi.org/10.3390/healthcare6020033) PMCID: PMC6023324 PMID: [29662016](https://pubmed.ncbi.nlm.nih.gov/29662016/)

Mayne P, English JS, Kilbane EJ, Burke JM, Middelveen MJ, Stricker RB (2013) Morgellons: a novel dermatological perspective as the multisystem infective disease borreliosis [v1; ref status: awaiting peer



review, doi: 10.12688/f1000research.2-118.v1 <http://f1000research.com/articles/2-118/v1>  
Finch JJ, Wald J, Ferenczi K, Khalid S, Murphy M. (2014) Disseminated Lyme Disease Presenting With Nonsexual Acute Genital Ulcers. *JAMA Dermatology*. <http://doi.org/10.1001/jamadermatol.2014.1072>  
Walker R (2015) Mystery Of Morgellons - Disease Or Delusion - Scientific Hypothesis Of Connection With Lyme Disease. *Science 2.0* (<http://www.science20.com>)  
[http://www.science20.com/robert\\_inventor/mystery\\_of\\_morgellons\\_disease\\_or\\_delusion\\_scientific\\_hypothesis\\_of\\_connection\\_with\\_lyme\\_disease-155742](http://www.science20.com/robert_inventor/mystery_of_morgellons_disease_or_delusion_scientific_hypothesis_of_connection_with_lyme_disease-155742)

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

### **2.12.3 Lichen sclerosus**

#### **Immunosystem**

Belz Doreen (2013) Expression von regulatorischen T-Zellen beim genitalen Lichen sclerosus. Inaugural Dissertation, Ruhr Universität Bochum.

<http://www-brs.ub.ruhr-uni-bochum.de/netahtml/HSS/Diss/BelzDoreen/diss.pdf>

#### **Viruses**

Aid S, Lattario FR et al. (2010) Epstein-Barr Virus and Human Papillomavirus Infection in Vulvar Lichen Sclerosus. *Journal of Lower Genital Tract Disease*. 14, 319–322, doi:10.1097/LGT.0b013e3181d734f1

#### **Bacteria**

Asbrink E (1985) Erythema chronicum migrans Afzelius and acrodermatitis chronica atrophicans. Early and late manifestations of Ixodes ricinus-borne Borrelia spirochetes. *Acta Dermato-venereologica. Supplementum* [01 Jan 1985, 118:1-63]

Aberer E, Kollegger H, et al. (1988) Neuroborreliosis in morphea and lichen sclerosus et atrophicus. *JAAD* 19(5), 1, 820-825 [http://www.jaad.org/article/S0190-9622\(88\)70239-X/abstract](http://www.jaad.org/article/S0190-9622(88)70239-X/abstract)

Schempp Chr, Bocklage H, Lange R et al. (1993) Further Evidence for Borrelia burgdorferi Infection in Morphea and Lichen Sclerosus et Atrophicus Confirmed by DNA Amplification. *Journal of Investigative Dermatology*. 100 (5), 717-720

Schempp C, Bocklage H, Lange R et al. (1993) Further evidence for Borrelia burgdorferi infection in morphea and lichen sclerosus et atrophicus confirmed by DNA amplification. *The Journal of investigative dermatology*. Band 100, Nummer 5, S. 717–720, ISSN 0022-202X. PMID 8491994.

Trevisan G, Rees DH, Stinco G. (1994) Borrelia burgdorferi and localized scleroderma. *Clin Dermatol*. 12(3), 475-9.

Colomé-Grimmer MI, Payne DA, Tying SK, Sánchez RL. (1997) Borrelia burgdorferi DNA and Borrelia hermsii DNA are not associated with morphea or lichen sclerosus et atrophicus in the southwestern United States. *Acta Derm Venereol*. 77(4), 299-304.

Fujiwara H, Fujiwara K, Hashimoto K, et al. (1997) Detection of Borrelia burgdorferi DNA (B. garinii or B. afzelii) in morphea and lichen sclerosus et atrophicus tissues of German and Japanese but not of US patients. *Arch Dermatol* 133, 41–4.

Svecova D, Buchvald J. (2000) Borrelia burgdorferi antibodies in scleroderma circumscripta, lichen sclerosus et atrophicus, erythema nodosum, granuloma annulare, erythema annulare and chronic urticaria. *Int J Dermatol*. 39(4) 278-83.

Ozkan S, Atabey N, Fetil E, Erkizan V, Günes AT. (2000) Evidence for Borrelia burgdorferi in morphea and lichen sclerosus. *Int J Dermatol*. 39(4), 278-83.

Breier F, Khanakah G, Stanek G, Kunz G, Aberer E, Schmidt B, Tappeiner G. (2001) Isolation and polymerase chain reaction typing of Borrelia afzelii from a skin lesion in a seronegative patient with generalized ulcerating bullous lichen sclerosus et atrophicus. *Br J Dermatol*. 144(2), 387-92.

<http://www.ncbi.nlm.nih.gov/pubmed/11251580>

Kaya G, Berset M, Prins C, Chavaz P, Saurat J.-H. (2001) Chronic Borreliosis Presenting with Morphea- and Lichen sclerosus et atrophicus-Like Cutaneous Lesions. A Case Report. *Dermatology* 202, 373–375

<https://doi.org/10.1159/000051687>

<https://www.dropbox.com/s/amndvyjf0qim4wp/00005%20Chronic%20borreliosis%20presenting%20with%20morphea-%20and%20lichen%20sclerosus%20et%20atrophicus-like%20cutaneous%20lesions.%20a%20case%20report%20.pdf?dl=0>

Eisendle K, Grabner T, Kutzner H et al. (2008) Possible Role of Borrelia burgdorferi Senu Lato Infection in Lichen Sclerosus. *Archives of Dermatology*. 144, S. 591–598, doi:10.1001/archderm.144.5.591

Wilk M, Zelger B, Emberger M et al. (2016) Anular Lichenoid Dermatitis (of Youth) Immunohistochemical and Serological Evidence of Another Clinical Presentation of Borrelia Infection in Patients of West Austria. *Am J of*

Dermatology. doi: 10.1097/DAD.0000000000000621

[http://journals.lww.com/amjdermatopathology/Abstract/pubshahead/Annular\\_Lichenoid\\_Dermatitis\\_of\\_Youth\\_98764.aspx](http://journals.lww.com/amjdermatopathology/Abstract/pubshahead/Annular_Lichenoid_Dermatitis_of_Youth_98764.aspx)

„Lichen sclerosus et atrophicus and morphea have previously been reported to be possibly related to Borrelia infection. We postulate that a similar relationship to Borrelia infection may be true for ALDY implying that ALDY may be an early superficial stage of morphea“.

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## Neurologic and psychiatric diagnoses

### [2.12.4](#) Throat, nose, ears

#### **Bacteria**

Stoiber L, Stanek G (1989) Hörsturz und Vestibularisstörungen bei serologisch gesicherter Lyme-Borreliose. Verhandlungsbericht der Deutschen Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie Volume 1989 / 2, 42-43

[http://link.springer.com/chapter/10.1007%2F978-3-642-83931-3\\_29](http://link.springer.com/chapter/10.1007%2F978-3-642-83931-3_29)

Walther LE, Hentschel H, Oehme A, Gudziol H, Beleites E (2003) Die Lyme-Borreliose - eine Ursache für "Hörsturz" und "Vestibularisausfall"? Zeitschrift: LARYNGO- RHINO- OTOLOGIE, Ausgabe 82(4), 249-257

<http://www.neuro-depesche.de/nachrichten/akuter-hoerverlust-durch-borreliose/>

HINTERGRUND: Die Lyme-Borreliose wird als eine mögliche Ursache für die akute Innenohr-schwerhörigkeit und den akuten peripheren isolierten Vestibularisausfall diskutiert. Über die Notwendigkeit einer serologischen Diagnostik und deren therapeutische Konsequenzen gibt es gegensätzliche... [Ausführliche Beschreibung](#)

Espiney Amaro C, Montalvão P, Huins C, Saraiva J (2015) Lyme disease: sudden hearing loss as the sole presentation. J Laryngol Otol. 1-4. <http://www.ncbi.nlm.nih.gov/pubmed/25619547>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

### [2.12.5](#) Eyes

#### **Bacteria**

Wu G, Lincoff H, Ellsworth RM, Haik BG (1986) Optic disc edema and Lyme disease. Ann Ophthalmol 18(8), 252-5.

Balesewicz AA, Rupprecht KW, Naumann GOH et al. (1988) Bilateral diffuse choroiditis and exsudative retinal detachments with evidence of Lyme disease. Am J. Ophthalmol. 105, 419-420.

Baum J, Barza M, Weinstein P et al. (1988) Bilateral keratitis as a manifestation of Lyme disease. Am J Ophthalmol. 105,75–77.

Bertuch AW, Rocco E, Schwartz EG et al. (1988) Lyme disease: ocular manifestations. Ann Ophthalmol. 20, 376–378.

Aalberg TM (1989) The expanding ophthalmologic spectrum of Lyme disease. A. J. Ophthalmol. 107, 77-80

Winward KE, Smith JL, Culbertson WW, Paris-Hamelin A. (1989) Ocular Lyme borreliosis. Am J Ophthalmol 108(6), 651-7

Bienvenot M, Tranchant C, Flament J, Warter JM, Sahel J (1990) Oculomotor paralysis and Lyme disease. J Fr Ophthalmol 13(6-7) 339-42.

Kaufmann DJ, Wormser GP. (1990) Ocular Lyme disease: case report and review of the literature. Br J Ophthalmol 74(6), 325-7.

Smith JL, Winward KE, Nicholson DF et al. (1991) [Retinal vasculitis in Lyme borreliosis](#)

[J Clin Neuroophthalmol.](#) 11(1), 7-15. <http://www.ncbi.nlm.nih.gov/pubmed/1827466>

„... visual acuity of 20/15 in both eyes, and showed no progression of his vas- cular occlusions orrecurrence ... diffuse syphilitic chorioretinitis neuritis papulosa of Fuchs gummatous lesions of retinagummatous lesions originating in optic nerve syphilis of retinal blood vessels ...“ [Cited by 28 Related articles](#)

[Smith JL](#) (1991) Neuro-ocular Lyme borreliosis. [Neurol Clin.](#) 9(1), 35-53.

<http://www.ncbi.nlm.nih.gov/pubmed/2011111>

« Any patient who has a Bell's palsy (unilateral or bilateral), aseptic meningitis, chronic fatigue syndrome, atypical radiculoneuropathy, presenile dementia, atypical myopathy, or symptoms of atypical rheumatoid arthritis should be asked specifically about the following: visits to highly endemic areas, any known tick bites, any skin lesion suggestive of erythema migrans, any history of palpitations or of prior Bell's palsy, aching in joints (especially the knees), paresthesias,

chronic fatigue and depression, forgetfulness, and eye problems. Any patient showing a chronic iritis with posterior synechiae, vitritis in one or both eyes, an atypical pars planitis-like syndrome, big blind spot syndrome, and swollen or hyperemic optic discs should be asked the same questions. »

Liu AN (1993) Lyme disease in China and its ocular manifestations. *Zhonghua Yan Ke Zhi* 29(5), 271-3.

Zaidman GW (1993) [The ocular manifestations of Lyme disease](#). - *International ophthalmology clinics*, - [journals.lww.com](http://journals.lww.com)

„... Burgdorfer and Barbour isolated a new spirochete, called *Borrelia burgdorferi*, from the I . dammini tick. ... which may occur also in stage 2) Iritis Pars planitis Vitritis Choroiditis PanuveitisRetinal vasculitis Exudative retinal detachment Branch retinal artery occlusion skin rash ...“ [Cited by 11 Related](#)

Berglöff J et al. (1994) Ophthalmic Manifestations in Lyme Borreliosis, *Journal of Neuro-Ophthalmology* 14 (1), 15-20

Schubert HD, Greenebaum E, Neu HC (1994) Cytologically proven seronegative Lyme choroiditis and vitritis. *Retina* 14(1), 39-42.

Leys AM, Schönherr U, Lang GE et al. (1995) [Retinal vasculitis in Lyme borreliosis](#).

[Bull Soc Belge Ophtalmol](#). 259, 205-14. [europepmc.org http://www.ncbi.nlm.nih.gov/pubmed/8936779](http://www.ncbi.nlm.nih.gov/pubmed/8936779)

„... Moreover arterial occlusions were observed in two patients. ... Find all citations with this subject(default). Or filter your current search. Optic Neuritis. Formation of new blood vessels originating from the retinal veins and extending along the inner (vitreous) surface of the retina. ...“

[Lesser RL](#). (1995) Ocular manifestations of Lyme disease. [Am J Med](#). 98(4A), 60S-62S.

<http://www.ncbi.nlm.nih.gov/pubmed/7726193>

Brazis PW, Lee AG (1996) [Optic disk edema with a macular star](#). [Mayo Clin Proc](#). 71(12), 1162-6.

<http://www.ncbi.nlm.nih.gov/pubmed/8945487>

„Optic disk edema with a macular star is a descriptive term encompassing a heterogeneous group of disorders. The clinical features include sudden visual loss, swelling of the optic disk, peripapillary and macular exudates that may occur in a star pattern, and cells in the ...“ [Cited by 30 Related articles More](#)

Gérard P, Canaple S, Rosa A (1996) Meningopapillitis disclosing Lyme disease. *Rev Neurol (Paris)* 152(6-7), 476-8.

Mikkilä H, Seppälä I, Leirisalo-Repo M, Immonen I, Karma A. (1997) The etiology of uveitis: the role of infections with special reference to Lyme borreliosis. *Acta Ophthalmol Scand* 75(6), 716-9.

Savas R, Sommer A, Gueckel F, Georgi M. (1997) Isolated oculomotor nerve paralysis in Lyme disease: MRI. *Neuroradiology* 39(2), 139-41.

Meier P et al. (1998) Pars plana vitrectomy in *Borrelia burgdorferi* endophthalmitis. *Klin Monatsbl Augenheilkd* 213(6), 351-4 <http://www.ncbi.nlm.nih.gov/pubmed/10048013>

“Despite intravenous ceftriaxone-therapy *Borrelia burgdorferi* must have survived in the vitreous body. Further investigations are required with respect to the use of other antibiotics or immunosuppressives. »

[Reed JB](#), [Scales DK](#), [Wong MT](#) et al. (1998) *Bartonella henselae* neuroretinitis in cat scratch disease.

*Ophthalmology* 105(3), 459–466

[Mikkilä H](#), [Karma A](#), [Viljanen M](#), [Seppälä I](#) (1999) The laboratory diagnosis of ocular Lyme borreliosis. *Graefes Arch Clin Exp Ophthalmol*. 237(3), 225 - 30. <https://www.ncbi.nlm.nih.gov/pubmed/10090586/>

„For efficient diagnosis of ocular Lyme boreliosis, immunoblot analysis and PCR should be used in addition to ELISA. A positive PCR seems to be associated with a negative immunoblot.“

Mikkilä HO, Seppälä IJT, Viljanen MK, et al (2000) [The expanding clinical spectrum of ocular lyme borreliosis](#).

- *Ophthalmology*, - Elsevier 107(3), 581-587 <http://www.aaoptjournal.org/article/S0161-6420%2899%2900128-1/abstract>

„... One patient had branch retinal vein **occlusion** (patient 6, Fig 4). One patient with vitreitis had ...There are multiple, small, round, punched-out lesions in the peripheral **retina**. ... Figure 3. Patient 5. A, fluorescein fundus angiography showing leakage from **retinal** venules and cystoid ...“

[Cited by 80 Related articles More](#)

Wade NK, Levi L, Jones MR et al. (2000) [Optic disk edema associated with peripapillary serous retinal detachment: an early sign of systemic Bartonella henselae infection](#)

[Am J Ophthalmol](#). 130(3), 327-34. <http://www.ncbi.nlm.nih.gov/pubmed/11020412>

„... optic disk edema with a small detachment of the temporal peripapillary retina (Figure 2, E ... optic disk edema associated with serous detachment involving the fovea and occlusion of multiple ...recovery occurred in one patient as a result of multiple branch retinal arteriolar occlusions ...“

[Cunningham Jr ET](#), [Jane E Koehler JE](#) (2000) Ocular bartonellosis [American Journal of Ophthalmology](#) 130(3), 340–349 <http://www.ajo.com/article/S0002-9394%2800%2900573-0/abstract>

Rothermel H, Hedges TR 3rd, Steere AC. (2001) Optic neuropathy in children with Lyme disease. *Pediatrics* 108(2) 477-81.

Fatterpekar GM, Gottesman RI, Sacher M, Som PM (2002) Orbital Lyme disease: MR imaging before and after treatment: case report. *AJNR Am J Neuroradiol* 23(4), 657-9.

Carvounis PE, Mehta AP, Geist CE (2004) Orbital myositis associated with *Borrelia burgdorferi* (Lyme disease) infection. *Ophthalmology* 111(5) 1023-8.

Pérez de Arcelus M, Salinas A, García Layana A. (2008) Retinal manifestations of infectious diseases. An Sist Sanit Navar31 Suppl 3, 57-68. [Article in Spanish] Departamento de Oftalmología, Clínica Universitaria de Navarra, Pamplona, Spain. <http://www.ncbi.nlm.nih.gov/sites/pubmed/19169295>

„The retina and the choroids are richly vascularised structures and can therefore be colonised by germs via the haematogenous route in the course of a systemic infectious disease. The germs responsible for this type of infection can be fungi, viruses, bacteria and parasites. Ocular candidiasis is outstanding amongst these colonisations because of its frequency; it can manifest itself as an endophthalmitis with a slow and hidden course. The so-called ocular histoplasmosis syndrome, although it is infrequent in our setting, is an important cause of choroidal neovascularisation.

The viruses that most frequently affect the retina are of the herpes type and can produce devastating symptoms in immunoincompetent patients, named acute retinal necrosis syndrome. Retinitis due to cytomegalovirus is more frequent in immunodepressed patients, as in the case of AIDS, but it must also be contemplated in patients with lymphoma and immunomodulatory treatment.

The most frequent bacterial diseases that affect the retina are syphilis and tuberculosis. Disease due to cat scratches, caused by a borrelia, can produce a neuroretinitis.

Toxoplasmosis is the most common of the infectious diseases caused by a parasite and gives rise to chorioretinitis. Toxocariasis, also caused by a parasite, is second in importance, giving rise to choroidal granulomas and retinal tractions“.

Mora P, Carta A (2009) Ocular manifestations of Lyme borreliosis in Europe. Int J Med Sci 6(3), 124-125. doi:10.7150/ijms.6.124 <http://www.medsci.org/v06p0124.htm>

Accorinti M (2009) Ocular Bartonellosis. International Journal of Medical Sciences. 6(3), 131-132 <http://www.medsci.org/v06p0131.htm>

Sauer A, Hansmann Y, Jaulhac B, Bourcier T, Speeg-Schatz C. (2009) Five Cases of Paralytic Strabismus as a Rare Feature of Lyme Disease. Clin Infect Dis. Departments of 1Ophthalmology, 2Infectious Disease, Pole Specialty Medicine Ophthalmology Hygiene, and Bacteriology, Hopitaux Universitaires de Strasbourg, Strasbourg, France. <http://www.ncbi.nlm.nih.gov/pubmed/19193112>

„Lyme borreliosis can cause a variety of ocular manifestations, and the frequency of these manifestations among cases of Lyme disease involving systemic manifestations is approximately 1%“

Sauer A, Speeg-Schatz C, Hansmann Y (2011) Two Cases of Orbital Myositis as a Rare Feature of Lyme Borreliosis. Case Reports in Infectious Diseases Volume 2011 (2011), Article ID 372470, 3 pages <http://dx.doi.org/10.1155/2011/372470> <http://www.hindawi.com/journals/criid/2011/372470/>

Norfarizal Ashikin A et.al. (2014) Unilateral visual loss secondary to cat scratch disease in a healthy young man. Asian Pacific Journal of Tropical Disease. 5(1), 77–79 <http://www.sciencedirect.com/science/article/pii/S2222180814606319>

Berghoff W (2014) Augenerkrankungen bei LB. <https://www.praxis-berghoff.de/lehrbuch-lb/>

Correll MH, Datta N, Arvidsson HS et al. (2015) Lyme neuroborreliosis: a treatable cause of acute ocular motor disturbances in children. Br J Ophthalmol. pii: bjophthalmol-2015-306855. doi: 10.1136/bjophthalmol-2015-306855. <http://www.ncbi.nlm.nih.gov/pubmed/25868792>

«LNB can present as acute ocular motor disorders in conjunction with fatigue and other clinical manifestations. In endemic areas, children with unexplained, acquired ocular motor abnormalities should be evaluated for LNB, a treatable medical condition.»

Psatta DM, Rosca T (2015) Visual Disorders in Neuroborreliosis : An Electro-physiological Investigation. Journal of Health Science 3, 35-41 doi: 10.17265/2328-7136/2015.01.006 <http://www.davidpublisher.com/Public/uploads/Contribute/558cb98a4fc8c.pdf>

Sathiamoorthi S, Smith WM (2016) The eye and tick-borne disease in the United States. Curr Opin Ophthalmol, 27(6), 530-537

Tan CL, Fhun LC, Tai EL et al. (2017) Clinical Profile and Visual Outcome of Ocular Bartonellosis in Malaysia. J Trop Med. 2017, 7946123. doi: 10.1155/2017/7946123. Epub 2017 Feb 7. <https://www.ncbi.nlm.nih.gov/pubmed/28265290>

### **Toxins; Eye diseases in connection with Tattoos**

Rorsman H, Brehmer-Andersson E, Dahlquist I, Ehinger B, Jacobsson S, Linell F et al. (1996) Tattoo granuloma and uveitis. Lancet 2(7610) 27–28.

Moschos MM, Guex-Crosier Y. (2004) Retinal vasculitis and cystoid macular edema after body tattooing: a case report. Klin Monatsbl Augenheilkd 221(5), 424–426.

McGovern V (2005) Metal Toxicity: Tattoos: Safe Symbols? Environ Health Perspect. 113(9), A590. PMID: PMC1280436 Environews Forum. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1280436/>

Barabasi Z, Kiss E, Balaton G, Vajo Z. (2008) Cutaneous granuloma and uveitis caused by a tattoo. Wien Klin Wochenschr 120(1–2), 18.

Saliba N, Owen ME, Beare N (2010) Tattoo-associated uveitis. Eye 24, 1406; doi:10.1038/eye.2010.17. <http://www.nature.com/eye/journal/v24/n8/full/eye201017a.html>

Ostheimer TA, Burkholder BM, Leung TG (2014) Tattoo-Associated Uveitis. Am J Ophthalmol. 158(3), 637-43.e1. doi: 10.1016/j.ajo.2014.05.019. Epub 2014 May 27. <http://www.ncbi.nlm.nih.gov/pubmed/24875002>



## **2.12.6 Encephalomyelitis disseminata, Multiple Sklerosis, MS**

### **Virusarten, viruses**

- [Perron H, Perin JP, Rieger F, Alliel PM](#) (2000) Particle-associated retroviral RNA and tandem RGH/HERV-W copies on human chromosome 7q: possible components of a 'chain-reaction' triggered by infectious agents in multiple sclerosis? *J Neurovirol.* 6 Suppl 2, S67-75.
- [Perron H, Bernard C, Bertrand JB](#) et al. (2009) Endogenous retroviral genes, Herpesviruses and gender in Multiple Sclerosis. *J Neurol Sci.* 286(1-2), 65-72.
- [Firouzi R, Rolland A, Michel M](#), (2003) Multiple sclerosis-associated retrovirus particles cause T lymphocyte-dependent death with brain hemorrhage in humanized SCID mice model. *J Neurovirol.* 9(1), 79-93  
<http://www.ncbi.nlm.nih.gov/pubmed/12587071>
- [Christensen T](#). (2005) Association of human endogenous retroviruses with multiple sclerosis and possible interactions with herpes viruses. *Rev Med Virol.* 15(3), 179-211.
- [Cossu D, Masala S, Cocco E](#) et al. (2012) Are Mycobacterium avium subsp. paratuberculosis and Epstein-Barr virus triggers of multiple sclerosis in Sardinia? *Mult Scler.* 18(8), 1181-4. doi: 10.1177/1352458511433430. Epub 2012 Jan 19. <http://www.ncbi.nlm.nih.gov/pubmed/22261119>
- [Djelilovic-Vranic J, Alajbegovic A](#). (2012) Role of early viral infections in development of multiple sclerosis. *Med Arh.* 66(3 Suppl 1), 37-40.
- [Tselis A](#) (2012) Epstein-Barr virus cause of multiple sclerosis. *Curr Opin Rheumatol.* 24(4), 424-8. doi: 10.1097/BOR.0b013e3283542cf8. <https://www.ncbi.nlm.nih.gov/pubmed/22617821>
- [Olival GS, Lima BM, Sumita LM, Serafim V, Fink MC, Nali LH](#) et al. (2013) Multiple sclerosis and herpes virus interaction. *Arq Neuropsiquiatr.* 71(9B), 727-30. doi:10.1590/0004-282X20130160
- [Mameli G, Madeddu G, Mei A](#) et al. (2013) Activation of MSR-V-Type Endogenous Retroviruses during Infectious Mononucleosis and Epstein-Barr Virus Latency: The Missing Link with Multiple Sclerosis? *PLoS One.* 8(11), e78474. doi:10.1371/journal.pone.0078474. <http://www.ncbi.nlm.nih.gov/pubmed/24236019>
- "Thus, the data indicate that the two main links between EBV and MS (IM and high anti-EBNA-1-IgG titers) are paralleled by activation of the potentially neuropathogenic HERV-W/MSRV. These novel findings suggest HERV-W/MSRV activation as the missing link between EBV and MS, and may open new avenues of intervention."
- [Angelini DF, Serafini B, Piras E, Severa M, Coccia EM, Rosicarelli B, Ruggieri S, Gasperini C, Buttari F, Centonze D, Mechelli R, Salvetti M, Borsellino G, Aloisi F, Battistini L](#) (2013) Increased CD8+ T cell response to Epstein-Barr virus lytic antigens in the active phase of multiple sclerosis. *PLoS Pathog.* 9(4), e1003220. doi: 10.1371/journal.ppat.1003220. <http://www.ncbi.nlm.nih.gov/pubmed/23592979>,
- [Garcia-Montojo M, Dominguez-Mozo M, Arias-Leal A](#) et al. (2013) The DNA copy number of human endogenous retrovirus-W (MSRV-type) is increased in multiple sclerosis patients and is influenced by gender and disease severity. *PLoS One.* 8(1), e53623. doi: 10.1371/journal.pone.0053623.  
<http://www.ncbi.nlm.nih.gov/pubmed/23308264>
- "MSRV increases its copy number in PBMC of MS patients and particularly in women with high clinical scores. This may explain causes underlying the higher prevalence of MS in women. The association with the clinical severity calls for further investigations on MSRV load in PBMCs as a biomarker for MS."
- [Garcia-Montojo M, de la Hera B, Varadé J](#), et al. (2014) HERV-W polymorphism in chromosome X is associated with multiple sclerosis risk and with differential expression of MSRV. *Retrovirology.* 11(1), 2. <http://www.ncbi.nlm.nih.gov/pubmed/24405691>
- [Sutherland S](#) (2014) Remyelination: Are Exosomes Containing microRNA the Answer? Naturally produced exosomes with miRNA led to increased myelination in vitro and in vivo. *New Findings* | 13 Feb 2014  
[http://www.msdiscovery.org/news/new\\_findings/9751-remyelination-are-exosomes-containing-microrna-answer](http://www.msdiscovery.org/news/new_findings/9751-remyelination-are-exosomes-containing-microrna-answer)
- [Mameli G, Cossu D, Cocco E](#) et al. (2014) Epstein-Barr virus and Mycobacterium avium subsp. paratuberculosis peptides are cross recognized by anti-myelin basic protein antibodies in multiple sclerosis patients. *J Neuroimmunol.* pii:S0165-5728(14)00063-0. doi:10.1016/j.jneuroim.2014.02.013.  
<http://www.ncbi.nlm.nih.gov/pubmed/24642384>,
- [Lossius A, Johansen JN, Vartdal F, Robins H, Benth JS, Holmøy T, Olweus J](#). (2014) High-throughput sequencing of TCR repertoires in multiple sclerosis reveals intrathecal enrichment of EBV-reactive CD8+ T cells. *Eur J Immunol.* doi: 10.1002/eji.201444662. <http://www.ncbi.nlm.nih.gov/pubmed/25103993>
- [Mechelli R, Manzari C, Policano C](#) (2015) Epstein-Barr virus genetic variants are associated with multiple sclerosis. *Neurology.* pii: 10.1212/WNL.0000000000001420. [Epub ahead of print]  
<http://www.ncbi.nlm.nih.gov/pubmed/25740864>

« Our study unveils a strong association between Epstein-Barr virus genomic variants and MS, reinforcing the idea that Epstein-Barr virus contributes to disease development. »

Campbell A, Hogestyn JM, Folts ChrJ et al. (2017) Expression of the Human Herpesvirus 6A Latency-Associated Transcript U94A Disrupts Human Oligodendrocyte Progenitor Migration. *Scientific Reports*, 7 (1) DOI: [10.1038/s41598-017-04432-y](https://doi.org/10.1038/s41598-017-04432-y)

Hassani A, Corboy JR, Al-Salam S, Khan G (2018) Epstein-Barr virus is present in the brain of most cases of multiple sclerosis and may engage more than just B cells. *PLoS One*. 13(2), e0192109. doi:10.1371/journal.pone.0192109. eCollection 2018.

<https://www.ncbi.nlm.nih.gov/pubmed/29394264>

«To the best of our knowledge, this is the most comprehensive study demonstrating that EBV is present and transcriptionally active in the brain of most cases of MS and supports a role for the virus in MS pathogenesis. «

Pender MP, Csurhes PA, Smith C et al. (2018) Epstein-Barr virus-specific T cell therapy for progressive multiple sclerosis. *JCI Insight*. 3(22). pii: 124714. doi: 10.1172/jci.insight.124714. [Epub ahead of print]

<https://www.ncbi.nlm.nih.gov/pubmed/30429369>

„Further clinical trials are warranted to determine the efficacy of EBV-specific T cell therapy in MS“.

### **Bacteria**

Buzzard EF (1911) Spirochetes in M.S. *Lancet* 11, 98

Bullock WE (now Gye) (1913) MS agent in Rabbits *Lancet* 1185

Steiner G (1917) Spirochetes The Cause of MS. *Med Klin*

Simmering (1918) Spirochetes in MS by Darkfield Micro

Steiner G (1918) Guinea Pig Inoculation with MS infectious agent from Human

Steiner G (1919) MS Agent Inoculation into Monkeys

Gye F (1921) MS Agent In Rabbits Brain 14, 213

Kaberlah (1922) MS Agent In Rabbits. *Deutch Med Works*

Sicard (1922) MS Spirochetes in Animal Model. *Rev Neurol*

Stepanopoulo (1922) Spirochetes in the CSF of MS Patients

Schlossman (1923) MS Agent in Animal Model. *Rev Neuro*

Blacklock (1924) MS Agent in Animals. *Journal of Path and Bac*

Wilson (1927) The Rat as A Carrier of MS. *British Med Journal*

Steiner G (1927) Understanding the Pathogenesis of MS

Steiner G (1928) Spirochetes in the Human Brain of MS Patients

Rogers HJ (1932) The question of silver cells as proof of the spirochetal theory of disseminated sclerosis. *J. Neurol. and Psychopathol.* 13, 50

Simons (1933) Spirochetes in the CSF of MS Patients

Hassin (1939) Spirochete-like formations in MS

Adams (1948) Spirochetes within the Ventricle Fluid of Monkeys Inoculated from Human MS, Steiner G

(1952) Acute plaques in MS, their pathogenetic significance and the role of spirochetes as the etiological factor. *J. Neuropath. Exp. Neur.* 11(4), 343-372

Steiner G (1954) Morphology of Spirocheta Myelophtora in MS. *J. Neuropath. Exp. Neur.* 13, 221-29

Steiner G (1954) Acute plaques in M.S., their pathogenetic significance and the role of spirochetes as the etiological factor. *J. Neuropath. and Exp. Neur.* 11:no 4, 343, 1954

Ichelson R (1957) Cultivation of Spirochetes from Spinal Fluids of MS Cases with Negative Controls. *Procl. Soc. Exp. Biol Med* 70, 411

Source of origin : MARYLAND LYME Spirochetes and MS References

<https://sites.google.com/site/marylandlyme/spirochetes/spirochetes-ms-references>

Gay D (1986) Is multiple sclerosis caused by an oral spirochaete? *Lancet* (1986 Jul 12) 2(8498), 75-7

Kurtz SK (1986) Relapsing fever/Lyme disease – Multiple sclerosis. *Medical Hypotheses*, 21(3) 335-343

[http://www.unboundmedicine.com/medline/citation/3642202/Relapsing\\_fever/Lyme\\_disease\\_Multiple\\_sclerosis](http://www.unboundmedicine.com/medline/citation/3642202/Relapsing_fever/Lyme_disease_Multiple_sclerosis)

Marshall V (1988) Multiple sclerosis is a chronic central nervous system infection by a spirochetal agent. *Med Hypotheses* (1988 Feb) 25(2), 89-92 <http://www.ncbi.nlm.nih.gov/pubmed/3357458>

Liegner KB. (1990) Evidence for a borrelial etiology and pathogenesis in a series of patients carrying a diagnosis of multiple sclerosis. (abstract). *International Northwestern Conference on Diseases in Nature Communicable to Man.* Hamilton, MT.

Liegner KB (1992) Evidence for borrelial etiology and pathogenesis in a series of patients carrying a diagnosis of multiple sclerosis [abstract]. 45<sup>th</sup> *International Northwestern Conference on Diseases in Nature Communicable to Man.* Vancouver, British Columbia.

Smielewska-Badora J (2000) Lyme borreliosis and Multiple sclerosis: Any Connection? A Seroepidemic study. *Ann Agric Environ Med.* 7(2), 141-3. <https://www.ncbi.nlm.nih.gov/pubmed/11153045>

Rostasy K, Reiber H, Pohl D et al. (2003) Chlamydia pneumoniae in children with MS: Frequency and quantity of intrathecal antibodies. *Neurology* 61, 125-128 <http://www.ncbi.nlm.nih.gov/pubmed/12847174>

Fritzsche M (2005) Chronic Lyme borreliosis at the root of multiple sclerosis--is a cure with antibiotics

attainable? *Med Hypotheses*. 64(3), 438-48 <http://www.ncbi.nlm.nih.gov/pubmed/15617845>  
[http://www.lymepa.org/Chronic Lyme borreliosis at the root of Multiple Sclerosis and a possible cure with antibiotics.pdf](http://www.lymepa.org/Chronic_Lyme_borreliosis_at_the_root_of_Multiple_Sclerosis_and_a_possible_cure_with_antibiotics.pdf)  
 Cossu D, Masala S, Cocco E et al. (2012) Are Mycobacterium avium subsp. paratuberculosis and Epstein-Barr virus triggers of multiple sclerosis in Sardinia? *Mult Scler*. 18(8), 1181-4.  
 doi:10.1177/1352458511433430. <http://www.ncbi.nlm.nih.gov/pubmed/22261119>  
 Jangi S et al. (2016) Alterations of the human gut microbiome in multiple sclerosis. *Nat Commun* 7, 12015.  
[https://www.researchgate.net/publication/304539080\\_ARTICLE\\_Alterations\\_of\\_the\\_human\\_gut\\_microbiome\\_in\\_multiple\\_sclerosis](https://www.researchgate.net/publication/304539080_ARTICLE_Alterations_of_the_human_gut_microbiome_in_multiple_sclerosis)  
 Barazin SE et al. (2017) The MS-Associated Gut Microbiome.  
[https://www.researchgate.net/publication/316237673\\_The\\_MS-Associated\\_Gut\\_Microbiome](https://www.researchgate.net/publication/316237673_The_MS-Associated_Gut_Microbiome)  
 Tankou SK et al. (2018) Investigation of probiotics in multiple sclerosis. *Mult Scler* 24, 58-63.  
[https://www.researchgate.net/publication/322333353\\_Investigation\\_of\\_probiotics\\_in\\_multiple\\_sclerosis](https://www.researchgate.net/publication/322333353_Investigation_of_probiotics_in_multiple_sclerosis)  
 Kriesel JD, Bhetariya P, Wang ZM, Renner D, Palmer C, Fischer KF (2019) Spectrum of Microbial Sequences and a Bacterial Cell Wall Antigen in Primary Demyelination Brain Specimens Obtained from Living Patients. *Sci Rep*. 9(1), 1387. doi: 10.1038/s41598-018-38198-8.  
 „ Human gene expression analysis showed increased expression of inflammation-related pathways in the MS group. This data shows that demyelinating brain lesions are associated with the presence of microbial RNA sequences and bacterial antigen. This suggests that MS is triggered by the presence of a diverse set of microbes within a lesion. »  
**Protozoa**  
 Kissler H. (2001) Is Multiple Sclerosis caused by a silent infection with malarial parasites? *Med Hypotheses* 57, 292-301  
**Nematodes**  
 INNES JR, SHOHO C (1952) Nematodes, nervous disease, and neurotropic virus infection; observations in animal pathology of probable significance in medical neurology. *Br Med J*. 2(4780), 366-8. PMID: [14944823](https://pubmed.ncbi.nlm.nih.gov/14944823/)  
 PMCID: [PMC2021051](https://pubmed.ncbi.nlm.nih.gov/pmc/articles/PMC2021051/) <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2021051/>  
 INNES JR, SHOHO C (1953) Cerebrospinal nematodiasis: focal encephalomyelomalacia of animals caused by nematodes (*Setaria digitata*); a disease which may occur in man. *AMA Arch Neurol Psychiatry*. 70(3), 325-49. PMID: [13079357](https://pubmed.ncbi.nlm.nih.gov/13079357/) <http://www.ncbi.nlm.nih.gov/pubmed/13079357>  
 Fleming JO, Cook TD (2006) Multiple sclerosis and the hygiene hypothesis. *Neurology*. 67, 2085–2086.  
[Crossref PubMed](#) | [Scopus \(86\)](#)  
 Correale J, Farez M (2007) Association between parasite infection and immune responses in multiple sclerosis. *Ann Neurol*. 61, 97–108. [Crossref](#) | [PubMed](#) | [Scopus \(235\)](#)  
 Correale J, Farez M, Razzitte G (2008) Helminth infections associated with multiple sclerosis induce regulatory B cells. *Ann Neurol*. 64, 187–199.  
 Correale J, Farez M (2009) Helminth antigens modulate immune responses in cells from multiple sclerosis patients through TLR2-dependent mechanisms. *J Immunol*. 183, 5999–6012. [Crossref](#) | [PubMed](#) | [Scopus \(66\)](#)  
 MacDonald A (2016) Nematode filarial Worms in cerebrospinal fluid of a Multiple Sclerosis patient at autopsy [version 1; not peer reviewed]. *F1000Research* 79 (poster) (doi:[10.7490/f1000research.1111264.1](https://doi.org/10.7490/f1000research.1111264.1))

[Back](#)

Windows Alt + left arrow  
 Apple to start Fn + left arrow

## [2.12.7 Amyotrophic Lateralsclerosis, ALS](#)

### Immunosystem

Cashman NR, Gurney ME, Antel JP. (1985) Immunology of amyotrophic lateral sclerosis. *Springer Semin Immunopathol*. 8(1-2), 141-52. Review.  
 Cruts M, Engelborghs S, van der Zee J, Van Broeckhoven C (1993) C9orf72-Related Amyotrophic Lateral Sclerosis and Frontotemporal Dementia. In Adam MP, Ardinger HH, Pagon RA, Wallace SE, Bean LJ, Stephens K, Amemiya A. [GeneReviews](#). Seattle (WA): University of Washington, Seattle. PMID [25577942](https://pubmed.ncbi.nlm.nih.gov/25577942/)  
 Jeong SY, Rathore KI, Katrin Schulz K (2009) Dysregulation of Iron Homeostasis in the CNS Contributes to Disease Progression in a Mouse Model of Amyotrophic Lateral Sclerosis. *The Journal of Neuroscience*, 29(3), 610-619; doi: 10.1523/JNEUROSCI.5443-08.2009 <http://www.jneurosci.org/content/29/3/610.short>  
 „These data suggest that iron chelator therapy might be useful for the treatment of ALS.“  
 Mitchell J, Paul P, Chen HJ et al. (2010) Familial amyotrophic lateral sclerosis is associated with a mutation in D-amino acid oxidase. In: *Proc. Natl. Acad. Sci. U.S.A.* 107(16), 7556–7561, doi:[10.1073/pnas.0914128107](https://doi.org/10.1073/pnas.0914128107), PMID [20368421](https://pubmed.ncbi.nlm.nih.gov/20368421/), PMC [2867752](https://pubmed.ncbi.nlm.nih.gov/pmc/articles/PMC2867752/) <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2867752/>  
 „DAO [mutation in the D-amino acid oxidase gene (R199W DAO)] controls the level of D-serine, which accumulates in the spinal cord in cases of sporadic ALS and in a mouse model of ALS, indicating that this abnormality may represent a fundamental component of ALS pathogenesis.“

Deng HX, Chen W et al. (2011) Mutations in UBQLN2 cause dominant X-linked juvenile and adult-onset ALS and ALS/dementia. In: Nature. [doi:10.1038/nature10353](https://doi.org/10.1038/nature10353)

„Here we show that mutations in UBQLN2, which encodes the ubiquitin-like protein ubiquilin-2, cause dominantly inherited, chromosome-X-linked ALS and ALS/dementia. We describe novel ubiquilin-2 pathology in the spinal cords of ALS cases and in the brains of ALS/dementia cases with or without UBQLN2 mutations. Ubiquilin-2 is a member of the ubiquilin family, which regulates the degradation of ubiquitinated proteins. Functional analysis showed that mutations in UBQLN2 lead to an impairment of protein degradation. Therefore, our findings link abnormalities in ubiquilin-2 to defects in the protein degradation pathway, abnormal protein aggregation and neurodegeneration, indicating a common pathogenic mechanism that can be exploited for therapeutic intervention“.

DeJesus-Hernandez M, Mackenzie IR, Boeve BF et al. (2011) [Expanded GGGGCC hexanucleotide repeat in noncoding region of C9ORF72 causes chromosome 9p-linked FTD and ALS](https://doi.org/10.1016/j.neuron.2011.09.011). Neuron. 72 (2), 245–56. [doi:10.1016/j.neuron.2011.09.011](https://doi.org/10.1016/j.neuron.2011.09.011). [PMC 3202986](https://pubmed.ncbi.nlm.nih.gov/21944778/). [PMID 21944778](https://pubmed.ncbi.nlm.nih.gov/21944778/).

Renton AE, Majounie E, Waite A et al. (2011) [A hexanucleotide repeat expansion in C9ORF72 is the cause of chromosome 9p21-linked ALS-FTD](https://doi.org/10.1016/j.neuron.2011.09.010). Neuron. 72 (2), 257–68. [doi:10.1016/j.neuron.2011.09.010](https://doi.org/10.1016/j.neuron.2011.09.010). [PMC 3200438](https://pubmed.ncbi.nlm.nih.gov/21944779/). [PMID 21944779](https://pubmed.ncbi.nlm.nih.gov/21944779/).

Herdewyn S, Zhao H, Moisse M, Race V, Matthijs G, Reumers J, Kusters B, Schelhaas HJ, van den Berg LH, Goris A, Robberecht W, Lambrechts D, Van Damme P (2012) [Whole-genome sequencing reveals a coding non-pathogenic variant tagging a non-coding pathogenic hexanucleotide repeat expansion in C9orf72 as cause of amyotrophic lateral sclerosis](https://doi.org/10.1093/hmg/dds055). Hum. Mol. Genet. 21 (11), 2412–9. [doi:10.1093/hmg/dds055](https://doi.org/10.1093/hmg/dds055). [PMC 3349421](https://pubmed.ncbi.nlm.nih.gov/22343411/). [PMID 22343411](https://pubmed.ncbi.nlm.nih.gov/22343411/).

Friedland RP, Shah JJ, Farrer LA, Vardarajan B, Rebolledo-Mendez JD, Mok K, Hardy J (2012) [Behavioral variant frontotemporal lobar degeneration with amyotrophic lateral sclerosis with a chromosome 9p21 hexanucleotide repeat](https://doi.org/10.3389/fneur.2012.00136). Front Neurol. 3, 136. [doi:10.3389/fneur.2012.00136](https://doi.org/10.3389/fneur.2012.00136). [PMC 3463813](https://pubmed.ncbi.nlm.nih.gov/23060854/). [PMID 23060854](https://pubmed.ncbi.nlm.nih.gov/23060854/)

Boeve BF, Boylan KB, Graff-Radford NR et al. (2012) [Characterization of frontotemporal dementia and/or amyotrophic lateral sclerosis associated with the GGGGCC repeat expansion in C9ORF72](https://doi.org/10.1093/brain/aws004). Brain. 135 (Pt 3), 765–83. [doi:10.1093/brain/aws004](https://doi.org/10.1093/brain/aws004). [PMC 3286335](https://pubmed.ncbi.nlm.nih.gov/22366793/). [PMID 22366793](https://pubmed.ncbi.nlm.nih.gov/22366793/)

### **Bacteria**

Waisbren BA, Cashman N, Schell RF, Johnson R. (1987) *Borrelia burgdorferi* antibodies and amyotrophic lateral sclerosis. Lancet. 2(8554), 332-3.

Fredrikson S, Link H. (1988) CNS-borreliosis selectively affecting central motor neurons. Acta Neurol Scand 78, 181-184 [Medline].

EIAlaoui F, Medejel A, AlZemmouri K, Yahyaoui M, Chkili T. (1990) Syphilitic lateral amyotrophic sclerosis. A study of 5 cases. Rev Neurol 146, 41-44 [Medline].

Halperin JJ, Kaplan GP, Brazinsky S, Tsai TF, Cheng T, Ironside A, Wu P, Delfiner J, Golightly M, Brown RH, et al. (1990) Immunologic reactivity against *Borrelia burgdorferi* in patients with motor neuron disease. Arch Neurol. 47(5), 586-4 <http://www.ncbi.nlm.nih.gov/pubmed/2334308>

„There appears to be a statistically significant association between ALS and immunoreactivity to *B. burgdorferi*, at least among men living in hyperendemic areas.“

Hänsel Y, Ackerl M, Stanek G (1946, 1995) ALS-like sequelae in chronic neuroborreliosis.. Wiener medizinische Wochenschrift 145(7-8), 186–8 [Abstract URL](#) [BibTeX4](#)

Li YR, King OD, Shorter J, Gitler AD (2013) [Stress granules as crucibles of ALS pathogenesis](https://doi.org/10.1083/jcb.201302044). Journal of Cell Biology 201, 361–372. <https://doi.org/10.1083/jcb.201302044>

Miller AI (2017) Lyme Disease and ALS. <https://www.youtube.com/watch?v=Fr61GV8JCYQ>

### **Mycoses, Fungi**

Alonso R, Pisa D, Fernández-Fernández AM (2017) Fungal infection in neural tissue of patients with amyotrophic lateral sclerosis. Neurobiol Dis. 108, 249-260. doi: 10.1016/j.nbd.2017.09.001. Epub 2017 Sep 6. <https://www.ncbi.nlm.nih.gov/pubmed/28888971>

„Overall, our present observations provide strong evidence for mixed fungal infections in ALS patients. The exact mixed infection varies from patient to patient consistent with the different evolution and severity of symptoms in each ALS patient“.

### **Toxins**

Watts DL (1988) The Nutritional Relationships of Iron. Journal of Orthomolecular Medicine 3(3) <http://www.tracelements.com/Docs/The%20Nutritional%20Relationships%20of%20Iron.pdf>

Yasui M, Ota K, Garruto RM et al. (1993) Concentrations of zinc and iron in the brains of Guamanian patients with amyotrophic lateral sclerosis and parkinsonism-dementia. Neurotoxicology. 14(4), 445-50. <http://www.ncbi.nlm.nih.gov/pubmed/8164889>

Zecca L, Youdim MB, Riederer P, Connor JR, Crichton RR. (2004) Iron, brain ageing and neurodegenerative disorders. Nat Rev Neurosci. 5(11), 863-73. [PubMed](https://pubmed.ncbi.nlm.nih.gov/15496864/). <http://www.ncbi.nlm.nih.gov/pubmed/15496864>

“By studying the accumulation and cellular distribution of iron during ageing, we should be able to increase our understanding of these neurodegenerative disorders and develop new therapeutic strategies.”

Mastroberardino PG, Hoffman EK, Horowitz MP et al. (2009) A novel transferrin/TfR2-mediated mitochondrial



iron transport system is disrupted in Parkinson's disease. *Neurobiol. Dis.* 34(3), 417–431, doi:10.1016/j.nbd.2009.02.009, PMID 19250966, PMC 2784936

<https://www.ncbi.nlm.nih.gov/pubmed/19250966>

Wang Q, Zhang X, Chen S, Zhang X et al. (2011) Prevention of motor neuron degeneration by novel iron chelators in SOD1(G93A) transgenic mice of amyotrophic lateral sclerosis. *Neurodegener Dis.* 8(5), 310-21.

doi: 10.1159/000323469. <http://www.ncbi.nlm.nih.gov/pubmed/21346313>

“These results provide evidence that iron is involved in the pathogenesis of ALS and iron chelation therapy may have the potential for the prevention and treatment of ALS”.

Rouault TA (2013) Iron metabolism in the CNS: implications for neurodegenerative diseases. *Nature Reviews Neuroscience* 14, 551–564 doi:10.1038/nrn3453

<https://www.nature.com/articles/nrn3453>

Veyrat-Durebex C, Corcia P, Mucha A (2014) Research Article. Iron Metabolism Disturbance in a French Cohort of ALS Patients. *BioMed Research International*. Volume 2014 (2014), Article ID 485723, 6 pages.

<http://dx.doi.org/10.1155/2014/485723> <http://www.hindawi.com/journals/bmri/2014/485723/>

„This is the first study showing a higher concentration of serum iron in ALS patients, strengthening the involvement of a deregulation of iron metabolism in ALS“.

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.12.8 Dementia, Alzheimer´s, Parkinson**

### **Immunosystem**

Iqbal K, Alonso AC, Chen S et al. (2005) Tau pathology in Alzheimer disease and other tauopathies. *Biochim Biophys Acta.* 1739, 198-210

Abramov E, Dolev I, Fogel H et al. (2009) Amyloid- $\beta$  as a positive endogenous regulator of release probability at hippocampal synapses. *Nature Neuroscience*. DOI: [10.1038/nn.2433](https://doi.org/10.1038/nn.2433)

<https://www.sciencedaily.com/releases/2009/11/091123114813.htm>

American Friends of Tel Aviv University. "Alzheimer's: Destructive amyloid-beta protein may also be essential for normal brain function." *ScienceDaily*. ScienceDaily, 25 November 2009.

[www.sciencedaily.com/releases/2009/11/091123114813.htm](http://www.sciencedaily.com/releases/2009/11/091123114813.htm)

Tukel C, Wilson RP, Nishimori M, et al. Responses to Amyloids of Microbial and Host Origin are mediated through Toll-like Receptor 2. *Cell Host Microbe.* 2009; 6: 45-53.

Zempel H, Thies E, Mandelkow E, et al. (2010) A $\beta$  Oligomers Cause Localized Ca<sup>2+</sup> Elevation, Missorting of Endogenous Tau into Dendrites, Tau Phosphorylation, and Destruction of Microtubules and Spines. *J Neurosci.* 30, 11938-11950.

Späni C, Suter T, Derungs R et al. (2015) Reduced  $\beta$ -amyloid pathology in an APP transgenic mouse model of Alzheimer's disease lacking functional B and T cells. *Acta Neuropathol Commun.* 3, 71. Published online 2015 Nov 11. doi: [10.1186/s40478-015-0251-x](https://doi.org/10.1186/s40478-015-0251-x) PMID: PMC4642668

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4642668/>

“The results of this study demonstrate an impact of the adaptive immunity on cerebral  $\beta$ -amyloid pathology in vivo and suggest an influence on microglia-mediated amyloid  $\beta$ -peptide clearance as a possible underlying mechanism”.

Abbott A (2016) The red-hot debate about transmissible Alzheimer's. *Nature.* 531(7594), 294-7. doi: 10.1038/53129 <https://www.ncbi.nlm.nih.gov/pubmed/269835224a>. <https://www.nature.com/news/the-red-hot-debate-about-transmissible-alzheimer-s-1.19554>

DiBiagio JR, Joshi SG, Allen HB (2016) Alzheimer's disease: A Commentary on Biofilms, Beta Amyloid and their Locations. *J Infect Dis Preve Med.* 4, 140.

Haass C, Neumann M (2016) [Frontotemporal dementia: from molecular mechanisms to therapy.](#) *J Neurochem.* 138 Suppl 1, 3-5. doi: 10.1111/jnc.13619.

Girolamo F, Coppola C, Ribatti D (2017) Immunoregulatory effect of mast cells influenced by microbes in neurodegenerative diseases. *Brain Behav Immun.* 65, 68-89. doi:10.1016/j.bbi.2017.06.017. Epub 2017 Jul 1.

<https://www.ncbi.nlm.nih.gov/pubmed/28676349>

Bredesen DE (2017) The End of Alzheimer's: The First Program to Prevent and Reverse Cognitive Decline.

[https://www.amazon.com/End-Alzheimers-Program-Prevent-](https://www.amazon.com/End-Alzheimers-Program-Prevent-Cognitive/dp/0735216207/ref=sr_1_1?ie=UTF8&qid=1504038086&sr=8-1&keywords=dale+bredesen)

[Cognitive/dp/0735216207/ref=sr\\_1\\_1?ie=UTF8&qid=1504038086&sr=8-1&keywords=dale+bredesen](https://www.youtube.com/watch?v=p6lkRXaQKwk)

<https://www.youtube.com/watch?v=p6lkRXaQKwk>

Vojdani, A, Vojdani, E, Saidara, E, Kharrazian, D (2018) Reaction of Amyloid- $\beta$  Peptide Antibody with Different Infectious Agents Involved in Alzheimer's Disease. *Journal of Alzheimer's Disease.* 63(2), 847-860 DOI: 10.3233/JAD-170961

Moir RD, Lathe R, Rudolph E, Tanzi RE (2018) The antimicrobial protection hypothesis of Alzheimer's disease. *Alzheimer's & Dementia*. 14(12), 1602-1614 <https://doi.org/10.1016/j.jalz.2018.06.3040>  
<https://www.sciencedirect.com/science/article/pii/S155252601833228X>

Jucker M (2015) Alzheimer und Gen-Mutation <https://www.youtube.com/watch?v=bVqh5XD5A7k>

Jucker M (2017) Fokus Demenz. <https://www.youtube.com/watch?v=pm2YMa92gJw>

### Neuroglia

Soreq L et al. (2017) Major shifts in glial regional identity are a transcriptional hallmark of human brain aging. *Cell Reports*. 18(2), p557–570, DOI: 10.1016/j.celrep.2016.12.011

[http://www.cell.com/cell-reports/abstract/S2211-1247\(16\)31684-9](http://www.cell.com/cell-reports/abstract/S2211-1247(16)31684-9)

[http://www.cell.com/cell-reports/pdf/S2211-1247\(16\)31684-9.pdf](http://www.cell.com/cell-reports/pdf/S2211-1247(16)31684-9.pdf)

Hoeijmakers L, Heinen Y, van Dam A-M et al. (2016) Microglial Priming and Alzheimer's Disease: A Possible Role for (Early) Immune Challenges and Epigenetics? *Front Hum Neurosci*. 10, 398.

doi:10.3389/fnhum.2016.00398 PMID: PMC4977314 PMID: 27555812

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4977314/#\\_ffn\\_sectitle](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4977314/#_ffn_sectitle)

### Viruses

Itzhaki R, Literature 1960 – 2016

<https://www.research.manchester.ac.uk/portal/en/researchers/ruth-itzhaki/fa70991a-96f8-45c9-8ba0-92a86ceccc84/publications.html?page=0>

### Herpes simplex virus TYP 1 (HSV1)

Wisniewsky HM (1978) Possible viral etiology of neurofibrillary changes and neuritic plaques. In *Alzheimer's Disease: Senile Dementia and Related Disorders (Aging, Vol 7)*, Katzman R, Terry RD, Bick KL, eds. Raven Press, New York, pp. 555-557.

Lord MA, [Itzhaki RF](#), Sutton RN (1980) [Detection of virus genome in human tissues](#). *The Lancet*. 2(8185), 92

Saldanha J, Sutton RN, Gannicliffe A et al. (1986) Detection of HSV1 DNA by in situ hybridisation in human brain after immunosuppression. *J Neurol Neurosurg Psychiatry* 49, 613–619.

Smith TA, Vallis Y, Neary D, [Itzhaki RF](#) (1989) [Characteristics of lymphocyte chromatin from Alzheimer's disease patients and from young and old normal individuals](#). *Gerontology*.35, 5-6

Jamieson GA, Maitland NJ, Wilcock GK, Craske J, Itzhaki RF (1991) Latent herpes simplex virus type 1 in normal and Alzheimer's disease brains. *J Med Virol* 33, 224–227.

Itzhaki RF, Lin WR, Shang D, Wilcock GK, Faragher B, Jamieson GA (1997) Herpes simplex virus type 1 in brain and risk of Alzheimer's disease. *Lancet* 349, 241–244.

Itzhaki RF, Wozniak MA (2008) Herpes simplex virus type 1 in Alzheimer's disease: The enemy within. *J Alzheimers Dis* 13, 393–405.

Itzhaki RF (2014) Herpes simplex virus type 1 and Alzheimer's disease: Increasing evidence for a major role of the virus. *Front Aging Neurosci* 6,202.

[Itzhaki R](#), Lathe R, Balin BJ et al. (2016) [Microbes and Alzheimer's Disease](#). *Journal of Alzheimer's Disease*. 51(4), 979-984 p. DOI: 10.3233/JAD-160152

[Itzhaki RF](#) (2018) Corroboration of a Major Role for Herpes Simplex Virus Type 1 in Alzheimer's Disease. *Front. Aging Neurosci.*, <https://doi.org/10.3389/fnagi.2018.00324>

<https://www.frontiersin.org/articles/10.3389/fnagi.2018.00324/full>

Beffert U, Bertrand P, Champagne D, Gauthier S, Poirier J (1998) HSV-1 in brain and risk of Alzheimer's disease. *Lancet* 351, 1330–1331.

Hemling N, Roytta M, Rinne J, Pollanen P, Broberg E, Tapio V, Vahlberg T, Hukkanen V (2003) Herpesviruses in brains in Alzheimer's and Parkinson's diseases. *Ann Neurol* 54, 267–271.

Wozniak MA, Itzhaki RF, Shipley SJ, Dobson CB (2007) Herpes simplex virus infection causes cellular beta-amyloid accumulation and secretase upregulation. *Neurosci Lett* 429, 95–100

Wozniak MA, Mee AP, Itzhaki RF (2009) Herpes simplex virus type 1 DNA is located within Alzheimer's disease amyloid plaques. *J Pathol* 217, 131–138.

Wozniak MA, Frost AL, Itzhaki RF (2009) Alzheimer's disease-specific tau phosphorylation is induced by herpes simplex virus type 1. *J Alzheimers Dis* 16, 341–350.

Wozniak MA, Frost AL, Preston CM, Itzhaki RF (2011) Antivirals reduce the formation of key Alzheimer's disease molecules in cell cultures acutely infected with herpes simplex virus type 1. *PLoS One* 6, e25152

Zambrano A, Solis L, Salvadores N, Cortes M, Lerchundi R, Otth C (2008) Neuronal cytoskeletal dynamic modification and neurodegeneration induced by infection with herpes simplex virus type 1. *J Alzheimers Dis* 14, 259–269.

Letenneur L, Peres K, Fleury H et al. (2008) Seropositivity to herpes simplex virus antibodies and risk of Alzheimer's disease: A population-based cohort study. *PLoS One* 3, e3637

De Chiara G, Marcocci ME, Civitelli L et al. (2010) APP processing induced by herpes simplex virus type 1 (HSV-1) yields several APP fragments in human and rat neuronal cells. *PLoS One* 5, e13989.

Cheng SB, Ferland P, Webster P, Bearer EL (2011) Herpes simplex virus dances with amyloid precursor

protein while exiting the cell. PLoS One 6, e17966.

Lerchundi R, Neira R, Valdivia S et al. (2011) Tau cleavage at D421 by caspase-3 is induced in neurons and astrocytes infected with herpes simplex virus type 1. *J Alzheimers Dis* 23, 513–520.

Bearer EL, Woltjer R, Donahue JE, Kilpatrick K (2013) Herpes encephalitis and Abeta plaques. *FASEB J* 27, 873.16.

Carter CJ (2013) Susceptibility genes are enriched in those of the herpes simplex virus 1/host interactome in psychiatric and neurological disorders. *Pathog Dis* 69, 240–261.

Ball MJ, Lukiw WJ, Kammerman EM, Hill JM (2013) Intracerebral propagation of Alzheimer's disease: Strengthening evidence of a herpes simplex virus etiology. *Alzheimers Dement* 9, 169–175.

Lövheim H, Gilthorpe J, Adolfsson R, Nilsson LG, Elgh F (2014) Reactivated herpes simplex infection increases the risk of Alzheimer's disease. *Alzheimers Dement*. pii: S1552-5260(14)02421-2. doi: 10.1016/j.jalz.2014.04.522. [Epub ahead of print] <http://www.ncbi.nlm.nih.gov/pubmed/?term=25043910>

„Positivity for anti-HSV IgM, a sign of reactivated infection, was found to almost double the risk for AD, whereas the presence of anti-HSV IgG antibodies did not affect the risk.“

Lövheim H, Gilthorpe J, Johansson A, Eriksson S, Hallmans G, Elgh F (2015) Herpes simplex infection and the risk of Alzheimer's disease: A nested case-control study. *Alzheimers Dement*. 11(6), 587-92. doi: 10.1016/j.jalz.2014.07.157. Epub 2014 Oct 7. <https://www.ncbi.nlm.nih.gov/pubmed/25304990>

Lövheim H, Gilthorpe J, Adolfsson R, Nilsson LG, Elgh F (2015) Reactivated herpes simplex infection increases the risk of Alzheimer's disease. *Alzheimers Dement*. 11(6), 593-9. doi:10.1016/j.jalz.2014.04.522. <https://www.ncbi.nlm.nih.gov/pubmed/25043910>

Mancuso R, Baglio F, Cabinio M, Calabrese E, Hernis A, Nemni R, Clerici M. (2014) Titers of herpes simplex virus type 1 antibodies positively correlate with grey matter volumes in Alzheimer's disease. *J Alzheimers Dis*. 38(4), 741-5. doi: 10.3233/JAD-130977. <http://www.ncbi.nlm.nih.gov/pubmed/24072067>

Martin C, Aguila B, Araya P et al. (2014) Inflammatory and neurodegeneration markers during asymptomatic HSV-1 reactivation. *J Alzheimers Dis* 39, 849–859.

Bourgade K, Garneau H, Giroux G et al. (2015) Beta-amyloid peptides display protective activity against the human Alzheimer's disease-associated herpes simplex virus-1. *Biogerontology* 16, 85–98.

Bourgade K, Le PA, Bock C, Witkowski JM, Dupuis G, Frost EH, Fulop T Jr (2016) Protective effect of amyloid-beta peptides against herpes simplex virus-1 infection in a neuronal cell culture model. *J Alzheimers Dis*, doi: 10.3233/JAD-150652.

Civitelli L, Marcocci ME, Celestino I et al. (2015) Herpes simplex virus type 1 infection in neurons leads to production and nuclear localization of APP intracellular domain (AICD): Implications for Alzheimer's disease pathogenesis. *J Neurovirol* 21, 480–490.

Gillet L, Frederico B, Stevenson PG (2015) Host entry by gamma-herpesviruses – lessons from animal viruses? *Curr Opin Virol* 15, 34–40.

Piacentini R, Li Puma DD, Ripoli C et al. (2015) Herpes simplex virus type-1 infection induces synaptic dysfunction in cultured cortical neurons via GSK-3 activation and intraneuronal amyloid-beta protein accumulation. *Sci Rep* 5, 15444.

Harris SA, Harris EA (2015) Herpes Simplex Virus Type 1 and Other Pathogens are Key Causative Factors in Sporadic Alzheimer's Disease. *Journal of Alzheimer's Disease*, vol. Preprint, no. Preprint, 1-35. <http://content.iospress.com/articles/journal-of-alzheimers-disease/jad142853>

Nian-Sheng Tzeng, Chi-Hsiang Chung, Fu-Huang Lin et al. (2018) Anti-herpetic Medications and Reduced Risk of Dementia in Patients with Herpes Simplex Virus Infections—a Nationwide, Population-Based Cohort Study in Taiwan. *Neurotherapeutics* pp 1–13 | Cite as DOI <https://doi.org/10.1007/s13311-018-0611-x> <https://link.springer.com/article/10.1007/s13311-018-0611-x#citeas>

„The usage of anti-herpetic medications in the treatment of HSV infections was associated with a decreased risk of dementia. These findings could be a signal to clinicians caring for patients with HSV infections. »

Readhead B, Haure-Mirande J-V, Funk CC et al. (2018) *Multiscale Analysis of Independent Alzheimer's Cohorts Finds Disruption of Molecular, Genetic, and Clinical Networks by Human Herpesvirus*. PlumXMetrics. DOI: <https://doi.org/10.1016/j.neuron.2018.05.023> [https://www.cell.com/neuron/fulltext/S0896-6273\(18\)30421-5](https://www.cell.com/neuron/fulltext/S0896-6273(18)30421-5)

„Construct multiscale networks of the late-onset Alzheimer's disease (AD)-associated virome and observe pathogenic regulation of molecular, clinical, and neuropathological networks by several common viruses, particularly human herpesvirus 6A and human herpesvirus 7“.

**HIV Virus**

Stanley LC, Mrak RE, Woody RC et al. (1994) Glial cytokines as neuropathogenic factors in HIV infection: Pathogenic similarities to Alzheimer's disease. *J Neuropathol Exp Neurol* 53, 231–238.

Esiri MM, Biddolph SC, Morris CS (1998) Prevalence of Alzheimer plaques in AIDS. *J Neurol Neurosurg Psychiatry* 65, 29–33

Smith DB, Simmonds P, Bell JE (2014) Brain viral burden, neuroinflammation and neuro-degeneration in

HAART-treated HIV positive injecting drug users. *J Neurovirol* 20, 28–38.

### **Bacteria and misfolded proteins**

Schaudinn, FR, Hoffmann, E (1905) Vorläufiger Bericht über das Vorkommen von Spirochaeten in syphilitischen Krankheitsprodukten und bei Papillomen. *Arb. Gesundh.-Amt* 22, 527-534, 2 Abb.

Schaudinn, FR, Hoffmann, E (1905) Über Spirochaeta pallida bei Syphilis u. d. Unterschiede dieser Form gegenüber anderen Arten dieser Gattung. *Berliner Klin. Wschr.* 42, 673.

<https://www.karger.com/Article/Pdf/404310>

MacDonald, A. B. (1986) Borrelia in the brains of patients dying with dementia. *J. Am. Med. Assoc.* 256, 2195-2196.

MacDonald AB, Miranda JM (1987) Concurrent neocortical borreliosis and Alzheimer's disease. *Hum Pathol* 18(7), 759-61. Abstract

MacDonald AB (1988) Concurrent Neocortical Borreliosis and Alzheimer's Disease: Demonstration of a Spirochetal Cyst Form. *Annals of the New York Academy of Sciences, Lyme Disease and Related Disorders.* 539, 468–470

MacDonald AB (2006) Plaques of Alzheimer's disease originate from cysts of Borrelia burgdorferi, the Lyme disease spirochete, *Medical Hypothesis*, 67(3), 592-60

MacDonald AB (2006) Alzheimer's neuroborreliosis with trans-synaptic spread of infection and neurofibrillary tangles derived from intraneuronal spirochetes. *Med Hypotheses* 68(4), 822-5. Abstract

MacDonald AB (2006) Cystic borrelia in Alzheimer's disease and in non-dementia neuroborreliosis.

*Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, 2 (3), Supplement, Page S207, S275, S433

MacDonald AB (2006) *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, 2 (3), Supplement, S207, S275, S433.

MacDonald AB (2007) Alzheimer's disease Braak Stage progressions: reexamined and redefined as Borrelia infection transmission through neural circuits. *Med Hypotheses.* 68(5), 1059-64

MacDonald AB (2007) Alzheimer's neuroborreliosis with trans-synaptic spread of infection and neurofibrillary tangles derived from intraneuronal spirochetes. *Med Hypotheses.* 68(4), 822-5.

MacDonald, A. B. (2008) (on-line manuscript). Plaques of Alzheimers disease originate from cysts of Borrelia burgdorferi, the Lyme disease spirochete. Manuscript no. YMEHY-D-06-00134R1. Elsevier Editorial System™ for Medical Hypotheses. 5 pp.

MacDonald A, Grier TM, Pierce PK (2016) Diffuse cortical Lewy body dementia – two cases – linked by FISH studies of DNA hybridization and immunohistochemistry to tertiary Borrelia burgdorferi brain infection.

<https://f1000research.com/%20posters/5-127>

Pappolla MA, Omar R, Saran B, et al. (1989) Concurrent neuroborreliosis and Alzheimer's disease: analysis of the evidence. *Hum Pathol* 20(8), 753-7. Abstract

Miklossy J, Kuntzer T, Bogousslavsky J, Regli F, Janzer RC. (1990) Meningovascular form of neuroborreliosis: Similarities between neuropathological findings in a case of Lyme disease and those occurring in tertiary neurosyphilis. *Acta Neuropathol* 80. 568-572.

Miklossy J (1993) Alzheimer's disease - A spirochetosis? *Neuroreport* 4(7), 841-8. Abstract

Miklossy J (1993) Alzheimer's disease--a spirochetosis? *Neuroreport* 4(9), 1069. Full Citation

Miklossy J, Kasas S, Janzer RC, et al. (1994) Further ultrastructural evidence that spirochaetes may play a role in the aetiology of Alzheimer's disease. *Neuroreport* 5(10), 1201-4. Abstract

Miklossy J (1998) Chronic inflammation and amyloidogenesis in Alzheimer's disease: Putative role of bacterial peptidoglycan, a potent inflammatory and amyloidogenic factor. *Alzheimers Rev* 3, 45–51.

Miklossy J, Khalili K, Gern L, et al. (2004) Borrelia burgdorferi persists in the brain in chronic lyme neuroborreliosis and may be associated with Alzheimer disease. *J Alzheimers Dis* 6(6), 639-49; discussion 673-681. Abstract

Miklossy J, Kis A, Radenovic A, Miller L, Forro L, Martins RN, Reiss K, Darbinian N, Darekar P, Mihaly L, Khalili K. (2006) Beta-amyloid deposition and Alzheimer's type changes induced by Borrelia spirochetes. *Neurobiol Aging* 27, 228-236.

Miklossy J, Rosemberg S, McGeer PL (2006) Beta amyloid deposition in the atrophic form of general paresis in Alzheimer's Disease. *New advances. Proceedings of the 10th International Congress on Alzheimer's Disease (ICAD).* Iqbal K, Winblad B, Avila J, eds. Medimond, International Proceedings, pp. 429-433.

Miklossy J, Kis A, Radenovic A, Miller L, Forro L, Martins R, Reiss K, Darbinian N, Darekar P, Mihaly L, Khalili K (2006) Beta-amyloid deposition and Alzheimer's type changes induced by Borrelia spirochetes. *Neurobiol Aging* 27, 228–236.

Miklossy J. (2008) Chronic inflammation and amyloidogenesis in Alzheimer's disease – role of spirochetes. *J. Alzheimer's Dis.* 13(4), 381-391 <http://www.j-alz.com/issues/13/vol13-4.html> Abstract

Miklossy J. (2008) Biology and neuropathology of dementia in syphilis and Lyme disease. In *Handbook of Clinical Neurology*, 89 (3rd series) C Duyckaerts, I Litvan, Editors, 2008, Elsevier B.V. Chapter of Handbook



of Neurology Handbook of Clinical Neurology,89, 825-44

<http://www.miklossy.ch/media/ChapterHandbookClinNeurolFinalPdf.pdf>

Miklossy J, Kasas S, Zurn AD, McCall S, Yu S, McGeer PL. (2008) Persisting atypical and cystic forms of *Borrelia burgdorferi* and local inflammation in Lyme neuroborreliosis. *J. Neuroinflammation*. 5, 40 Doi: 10.1186/1742-2094-5-40.

Miklossy J (2011) Emerging roles of pathogens in Alzheimer disease. *Expert Rev Mol Med* e30. Abstract

Miklossy J. (2012) Chronic or late lyme neuroborreliosis: analysis of evidence compared to chronic or late neurosyphilis. *Open Neurol J*. 6, 146-57 <http://www.ncbi.nlm.nih.gov/pubmed/23346260>

Miklossy J. (2013) Lyme Neuroborreliosis, Lyme Dementia and Alzheimer's Disease

<http://www.youtube.com/watch?v=RftuNfcFxB4&list=PLbSMktQUOGfVVSaMBLyTNPW59MrR2EKvg>

Miklossy Y (2014) Letter to the editor. The lack of correlation between the incidence of Lyme disease and deaths due to Alzheimer's disease cannot reflect the lack of involvement of *Borrelia burgdorferi* in Alzheimer's dementia. <http://j-alz.com/node/384>

Miklossy J (2015) Historic evidence to support a causal relationship between spirochetal infections and Alzheimer's disease. *Frontiers in Aging Neuroscience*. 7(46), 1-12. 1- doi: 10.3389/fnagi.2015.00046

<http://journal.frontiersin.org/article/10.3389/fnagi.2015.00046/full>

<http://journal.frontiersin.org/article/10.3389/fnagi.2015.00046/abstract>

Miklossy J, McGeer PL (2016) Common mechanisms involved in Alzheimer's disease and type 2 diabetes: a key role of chronic bacterial infection and inflammation. *Aging (Albany NY)*. 8(4), 575-88. doi:

10.18632/aging.100921. <https://www.ncbi.nlm.nih.gov/pubmed/26961231>

„This article reviews the evidence for the presence of local inflammation and bacteria in type 2 diabetes and discusses host pathogen interactions in chronic inflammatory disorders. *Chlamydomyxa pneumoniae*, *Helicobacter pylori* and spirochetes are demonstrated in association with dementia and brain lesions in AD and islet lesions in type 2 diabetes.“

Riviere GR, Weisz SK, Adams DF, Thomas DD (1991) Pathogen-related oral spirochetes from dental plaque are invasive. *Infect Immun* 59, 3377–3380

Riviere GR, Riviere KH, Smith KS (2002) Molecular and immunological evidence of oral *Treponema* in the human brain and their association with Alzheimer's disease. *Oral Microbiol Immunol* 17, 113-118

Wanick C, Prohovnik I, Kaufman MA, Dwork AJ. (1995) Rapidly progressive frontal-type dementia associated with Lyme disease. *J Neuropsychiatry Clin Neurosci*. 7(3), 345-7

Balin BJ, Gérard HC, Arking EJ et al. (1998) Identification and localization of *Chlamydia pneumoniae* in the Alzheimer's brain. *Med Microbiol Immunol* 187, 23–42 <http://www.ncbi.nlm.nih.gov/pubmed/9749980>

Green DA, Masliah E, Vinters HV, Beizai P, Moore DJ, Achim CL (2005) Brain deposition of beta-amyloid is a common pathological feature in HIV positive patients. *AIDS* 19, 407–411.

Meer-Scherrer L, Chang Loa C, Adelson ME, et al. (2006) Lyme disease associated with Alzheimer's disease. *Curr Microbiol* 52(4), 330-2. Abstract

Blanc F, Philippi N, Cretin B, Kleitz C, Berly L, Jung B, Kremer S, Namer IJ, Sellal F, Jaulhac B, de Seze J. (2014) Lyme Neuroborreliosis and Dementia. *J Alzheimers Dis*. 41(4), 1087-93. doi: 10.3233/JAD-130446. PMID: 24762944

Allen HB, Morales D, Jones K, Joshi S (2016) Alzheimer's Disease: A Novel Hypothesis Integrating Spirochetes, Biofilm, and the Immune System. *J Neuroinfect Dis* 7, 200. doi:10.4172/2314-7326.1000200

Allen HB (2016) Alzheimer's disease: Assessing the Role of Spirochetes, Biofilms, the Immune System, and Beta Amyloid with regard to potential Treatment and Prevention. *J Alz Dis*. 53, 1271-1276

Allen HB, Allawh RM, Gresham K, Donnelly K, Goyal K (2018) Tertiary Lyme Disease. *Clin Microbiol* 7, 309. doi:10.4172/2327-5073.1000309

<https://www.omicsonline.org/open-access/tertiary-lyme-disease-2327-5073-1000309.pdf>

“We postulate that our patient with dementia had tertiary Lyme disease because Lyme spirochetes have been cultured from Alzheimer's disease brains and because PCR findings have also confirmed the presence of *Borrelia burgdorferi*. We have shown how the spirochetes are likely responsible for the biofilms in the organs involved; such biofilms are integral to the pathology noted in the disorders in question. We discuss how biofilm dispersers together with bactericidal antibiotics are or are not effective in treatment.”

Ide M, Harris M, Stevens A et al. (2016) Periodontitis and Cognitive Decline in Alzheimer's Disease. *PLoS One*. 11(3), e0151081. doi: 10.1371/journal.pone.0151081. eCollection 2016.

<http://www.ncbi.nlm.nih.gov/pubmed/26963387>

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0151081>

«Our data showed that periodontitis is associated with an increase in cognitive decline in Alzheimer's Disease, independent to baseline cognitive state, which may be mediated through effects on systemic inflammation.»

Chen CK, Wu YT, Chang YC (2017) Association between chronic periodontitis and the risk of Alzheimer's disease: a retrospective, population-based, matched-cohort study. *Alzheimers Res Ther*. 9, 56.

Bastian FO (2017) Combined Creutzfeldt-Jakob/ Alzheimer's Disease Cases are Important in Search for Microbes in Alzheimer's Disease. *J Alzheimers Dis*. 56(3), 867-873. doi: 10.3233/JAD-160999.

<https://www.ncbi.nlm.nih.gov/pubmed/28059790>

Alonso R, Pisa D, Fernández-Fernández AM, Carrasco L (2018) Infection of Fungi and Bacteria in Brain Tissue From Elderly Persons and Patients With Alzheimer's Disease. *Front. Aging Neurosci.*, <https://doi.org/10.3389/fnagi.2018.00159> <https://www.frontiersin.org/articles/10.3389/fnagi.2018.00159/full>

### **Chlamydia pneumoniae**

Balin BJ, Gérard HC, Arking EJ et al. (1998) Identification and localization of *Chlamydia pneumoniae* in the Alzheimer's brain. *Med Microbiol Immunol* 187, 23–42 <http://www.ncbi.nlm.nih.gov/pubmed/9749980>

Balin BJ, Little CS, Hammond CJ, Appelt DM, Whittum-Hudson JA, Gérard HC, Hudson AP (2008) *Chlamydia pneumoniae* and the etiology of late-onset Alzheimer's disease. *J Alzheimers Dis* 13, 371–380. <http://stephanie-on-health.blogspot.com/2009/12/10-evidence-that-infection-is.html>

Balin BJ Hudson AP (2014) Etiology and pathogenesis of late-onset Alzheimer's disease. *Curr Allergy Asthma Rep* 14, 417.

Little CS, Hammond CJ, MacIntyre A et al. (2004) *Chlamydia pneumoniae* induces Alzheimer-like amyloid plaques in brains of BALB/c mice. *Neurobiol Aging* 25, 419–429.

Little CS, Bowe A, Lin R, Litsky J, Fogel RM, Balin BJ, Fresa-Dillon KL (2005) Age alterations in extent and severity of experimental intranasal infection with *Chlamydia pneumoniae* in BALB/c mice. *Infect Immun* 73, 1723–1734.

Boelen E, Stassen FR, van der Ven AJ et al. (2007) Detection of amyloid beta aggregates in the brain of BALB/c mice after *Chlamydia pneumoniae* infection. *Acta Neuropathol* 114, 255–261

Maheshwari P, Eslick GD. (2014) Bacterial Infection and Alzheimer's Disease: A Meta-Analysis. *J Alzheimers Dis.* <http://www.ncbi.nlm.nih.gov/pubmed/25182736>

«We found over a ten-fold increased occurrence of AD when there is detectable evidence of spirochetal infection (OR: 10.61; 95% CI: 3.38-33.29) and over a four-fold increased occurrence of AD in a conservative risk estimate (OR 4.45; 95% CI: 2.33-8.52). We found over a five-fold increased occurrence of AD with Cpn infection (OR 5.66; 95% CI: 1.83-17.51). This study shows a strongly positive association between bacterial infection and AD».

Maheshwari P, Estlick GD (2015) Bacterial infection and Alzheimer's disease: a meta-analysis. *J Alzheimer Dis* 43(3) 957-66 <http://www.ncbi.nlm.nih.gov/pubmed/?term=25182736>

« We found over a five-fold increased occurrence of AD with Cpn infection (OR: 5.66; 95% CI: 1.83-17.51). This study shows a strongly positive association between bacterial infection and AD. »

### **Propionibacterium acnes**

Kornhuber HH (1995) Chronic anaerobic cortical infection in Alzheimer's disease: *Propionibacterium acnes*. *Neurol Psych Brain Res* 3, 177–182.

Kornhuber HH (1996) *Propionibacterium acnes* in the cortex of patients with Alzheimer's disease. *Eur Arch Psychiatry Clin Neurosci* 246, 108–109.

### **Helicobacter pylori**

Kountouras J, Tsolaki M, Gavalas E, Boziki M, Zavos C, Karatzoglou P, Chatzopoulos D, Venizelos I (2006) Relationship between *Helicobacter pylori* infection and Alzheimer disease. *Neurology* 66, 938–940.

### **Porphyromonas gingivalis**

Dominy SS, Lynch C, Ermini F et al. (2019) *Porphyromonas gingivalis* in Alzheimer's disease brains: Evidence for disease causation and treatment with small-molecule inhibitors. *Science Advances* 5(1), eaau3333 DOI: 10.1126/sciadv.aau3333 <http://advances.sciencemag.org/content/5/1/eaau3333>

Mackenzie D (2019) The hidden cause of disease. *New Scientist* 243(3242), 42-46

[https://doi.org/10.1016/S0262-4079\(19\)31488-5](https://doi.org/10.1016/S0262-4079(19)31488-5)

<https://www.sciencedirect.com/science/article/pii/S0262407919314885>

### **Mycoses, Fungi**

Pisa D, Alonso R, Juarranz A, Rábano A, Carrasco L (2013) Direct Visualization of Fungal Infection in Brains from Patients with Alzheimer's Disease. *J Alzheimers Dis.* [Epub ahead of print]

<http://www.ncbi.nlm.nih.gov/pubmed/25125470>

„Our findings provide an explanation for the hitherto elusive detection of fungi in AD brains, and are consistent with the idea that fungal cells are internalized inside neurons.“

Pisa D, Alonso R, Juarranz A, Rábano A, Carrasco L (2015) Direct visualization of fungal infection in brains from patients with Alzheimer's disease. *J Alzheimers Dis* 43, 613-624

Pisa D, Alonso R, Rabano A, Rodal I, Carrasco L (2015) Different brain regions are infected with fungi in Alzheimer's disease. *Sci Rep* 5, 15015.

Pisa D, Alonso R, Fernández-Fernández AM et al. (2017) Polymicrobial Infections In Brain Tissue From Alzheimer's Disease Patients. *Sci Rep.* 7(1), 5559. doi: 10.1038/s41598-017-05903-y.

<https://www.ncbi.nlm.nih.gov/pubmed/28717130>

«Finally, several structures that could belong to fungi or prokaryotes were detected using peptidoglycan and *Clostridium* antibodies, and PCR analysis revealed the presence of several bacteria in frozen brain tissue from AD patients. Thus, our results show that polymicrobial infections consisting of fungi and bacteria can be revealed in brain tissue from AD patients«.

Alonso R, Pisa D, Rábano A, Carrasco L (2014) Alzheimer's disease and disseminated mycoses. *European*

Journal of Clinical Microbiology & Infectious Diseases

<http://link.springer.com/article/10.1007/s10096-013-2045-z>

Alonso R, Pisa D, Marina AI et al. (2014) Fungal infection in patients with Alzheimer's disease. *J Alzheimers Dis* 41, 301–311.

Alonso R, Pisa D, Aguado B, Carrasco L (2017) Identification of Fungal Species in Brain Tissue from Alzheimer's Disease by Next-Generation Sequencing. *J Alzheimers Dis*. doi: 10.3233/JAD-170058. [Epub ahead of print] <https://www.ncbi.nlm.nih.gov/pubmed/28387676>

„Five genera were common to all nine patients: *Alternaria*, *Botrytis*, *Candida*, *Cladosporium*, and *Malassezia*. These observations could be used to guide targeted antifungal therapy for AD patients. Moreover, the differences found between the fungal species in each patient may constitute a basis to understand the evolution and severity of clinical symptoms in AD“.

Alonso R, Pisa D, Fernández-Fernández AM, Carrasco L (2018) Infection of Fungi and Bacteria in Brain Tissue From Elderly Persons and Patients With Alzheimer's Disease. *Front. Aging Neurosci.*

<https://doi.org/10.3389/fnagi.2018.00159>

<https://www.frontiersin.org/articles/10.3389/fnagi.2018.00159/full>

AlzForum (2015) Dementia à la Mold? Fungi May Lurk in Alzheimer's Brains

<https://groups.google.com/forum/m/#!topic/alt.health/Ddh23yeO4E4>

### **Nematoda**

McDonald A (2016) Parasitic Nematode Worms and *Borrelia* in Alzheimer's:

<https://spirodementia.wordpress.com/parasitic-nematode-worms-and-borrelia-in-alzheimers-poster-june-2016/>

[Click here to return to Section gateway – Borrelia Endosymbionts and Parasitic Nematode Worms in Alzheimer's Disease](#)

### **Air pollution, Nanoparticles**

Kirschvink JL, Kobayashi-Kirschvink A, Woodford BJ (1992) Magnetite biomineralization in the human brain. *Proceedings of the National Academy of Sciences of the United States of America*, 89 (16). pp. 7683-7687.

ISSN 0027-8424. <http://resolver.caltech.edu/CaltechAUTHORS:20130211-134215131>

<http://web.gps.caltech.edu/~jkirschvink/pdfs/PNASbrainMagnetite.pdf>

Pankhurst Q, Hautot D, Khan N, Dobson J (2008) Increased levels of magnetic iron compounds in Alzheimer's disease. *J Alzheimers Dis*. 13(1), 49-52. <http://www.ncbi.nlm.nih.gov/pubmed/18334756>

Moulton PV, Yang W (2012) Air Pollution, Oxidative Stress, and Alzheimer's Disease. Review Article. *Journal of Environmental and Public Health*. Volume 2012 (2012), Article ID 472751, 9 pages

<http://dx.doi.org/10.1155/2012/472751> <https://www.hindawi.com/journals/jep/2012/472751/citations/>

Teller S, Tahirbegi IB, Mir M et al. (2015) Magnetite-Amyloid- $\beta$  deteriorates activity and functional organization in an in vitro model for Alzheimer's disease. *Scientific Reports* 2015, 5, 17261

<https://www.readbyqxd.com/read/26608215/magnetite-amyloid-%C3%AE-deteriorates-activity-and-functional-organization-in-an-in-vitro-model-for-alzheimer-s-disease>

Chau-Ren Jung, Yu-Ting Lin, Bing-Fang Hwang (2015) Ozone, Particulate Matter, and Newly Diagnosed Alzheimer's Disease: A Population-Based Cohort Study in Taiwan. *J. Alzheimer Dis*. 44(2), 573-84

<http://www.pubfacts.com/detail/25310992/Ozone-particulate-matter-and-newly-diagnosed-Alzheimers-disease-a-population-based-cohort-study-in-T>

### **Toxins**

Portelius E, Durieu E, Bodin M et al. (2016) Specific Triazine Herbicides Induce Amyloid- $\beta$ 42 Production. *J Alzheimers Dis*. <http://www.ncbi.nlm.nih.gov/pubmed/27589520>

„In conclusion, several widely used triazines enhance the production of toxic, aggregation prone A $\beta$ 42/A $\beta$ 43 amyloids, suggesting the possible existence of environmental "Alzheimerogens" which may contribute to the initiation and propagation of the amyloidogenic process in late-onset AD.“

Killin LOJ, Starr JM, Shiue IJ, Russ TC (2016) Environmental risk factors for dementia: a systematic review *BMC Geriatrics* BMC series – open, inclusive and trusted 201616, 175 DOI: 10.1186/s12877-016-0342-y

<http://bmgeriatr.biomedcentral.com/articles/10.1186/s12877-016-0342-y>

“There is at least moderate evidence implicating the following risk factors: air pollution; aluminium; silicon; selenium; pesticides; vitamin D deficiency; and electric and magnetic fields.”

Pretorius E, Bester J, Kell DB (2016) A Bacterial Component to Alzheimer's-Type Dementia Seen via a Systems Biology Approach that Links Iron Dysregulation and Inflammagen Shedding to Disease. *J Alzheimers Dis*. 53(4), 1237-56. doi: 10.3233/JAD-160318. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5325058/>

<https://www.ncbi.nlm.nih.gov/pubmed/27340854>

[https://www.researchgate.net/publication/319664120\\_A\\_bacterial\\_component\\_to\\_Alzheimer%27s-type\\_dementia\\_seen\\_via\\_a\\_systems\\_biology\\_approach\\_that\\_links\\_iron\\_dysregulation\\_and\\_inflammagen\\_shedding\\_to\\_disease](https://www.researchgate.net/publication/319664120_A_bacterial_component_to_Alzheimer%27s-type_dementia_seen_via_a_systems_biology_approach_that_links_iron_dysregulation_and_inflammagen_shedding_to_disease)

« We review the evidence that iron dysregulation is one of the central causative pathway elements here, as this can cause each of the above effects. In addition, we review the evidence that dormant, non-growing bacteria are a crucial feature of AD, that their growth in vivo is normally limited by a lack of free iron, and that it is this iron dysregulation that is an important factor in their resuscitation. Indeed, bacterial cells can be observed by ultrastructural microscopy in the blood of AD patients. »

Mirza A, King A, Troakes C, Exley C (2017) Aluminium in brain tissue in familial Alzheimer's disease. *Journal*

of Trace Elements in Medicine and Biology 40, 30–36

«The unique quantitative data and the stunning images of aluminium in familial Alzheimer's disease brain tissue raise the spectre of aluminium's role in this devastating disease».

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.12.9 Neurologic Patients**

### **Immunosystem**

Piliero PJ, Fish DG, Preston S et al. (2003) Guillain-Barré Syndrome Associated with Immune Reconstitution. Clinical Infectious Diseases, 36(9), e111–e114, <https://doi.org/10.1086/368311>  
<http://cid.oxfordjournals.org/content/36/9/e111.short>

Ramesh G, Didier PJ, England JD et al. (2015) IMMUNOPATHOLOGY AND INFECTIOUS DISEASES. Inflammation in the Pathogenesis of Lyme Neuroborreliosis. The American Journal of Pathology. 185(5), 1344-1360 <http://www.ncbi.nlm.nih.gov/pubmed/25892509>

[Reiber H](#) (2016) Cerebrospinal fluid data compilation and knowledge-based interpretation of bacterial, viral, parasitic, oncological, chronic inflammatory and demyelinating diseases. Diagnostic patterns not to be missed in neurology and psychiatry. [Arq Neuropsiquiatr.](#) 74(4), 337-50. doi: 10.1590/0004-282X20160044.  
<http://www.ncbi.nlm.nih.gov/pubmed/27097008>

### **Viruses**

Ahmed S, Libman R, Wesson K et al. (2000) Guillain-Barré syndrome: An unusual presentation of West Nile virus infection. Neurology 55(1) 144-146 doi: <http://dx.doi.org/10.1212/WNL.55.1.144>  
<http://www.neurology.org/content/55/1/144.short>

Nicholson GL (2008) Chronic Bacterial and Viral Infections in Neurodegenerative and Neurobehavioral Diseases. Lab Medicine. 39(5), 291-9

### **Bacteria**

[Riggs CE](#) (1914) SYPHILITIC INFECTIONS OF THE CENTRAL NERVOUS SYSTEM. [Can Med Assoc J.](#) 4(1), 9–24. PMID: PMC406544 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC406544/?page=1>

[Serman AB](#), [Nelson S](#), [Barclay P](#) (1982) Demyelinating neuropathy accompanying Lyme disease. doi: <http://dx.doi.org/10.1212/WNL.32.11.1302> Neurology 32(11) 1302  
<http://www.neurology.org/content/32/11/1302.short>

[Pachner AR](#) (1988) Borrelia burgdorferi in the nervous system: the new "great imitator". Ann N Y Acad Sci. 539, 56-64.

[Pachner AR](#). (1989) Neurologic manifestations of Lyme disease, the new "great imitator". Rev Infect Dis. 11 Suppl 6, 1482-6.

[Pachner AR](#), [Duray P](#), [Steere AC](#) (1989) Central nervous system manifestations of Lyme disease. Arch Neurol. 46(7), 790-5.

[Schroeter V](#), [Belz GG](#), [Blenk H](#). (1988) Paralysis of recurrent laryngeal nerve in Lyme disease. [Lancet.](#) 2(8622), 1245. <http://www.ncbi.nlm.nih.gov/pubmed/2903968>

[Kollikowski HH](#), [Schwendemann G](#), [Schulz M](#), [Wilhelm H](#), [Lehmann HJ](#) (1988) [Chronic borrelia encephalomyeloradiculitis with severe mental disturbance: immunosuppressive versus antibiotic therapy.](#) J Neurol. 235(3), 140-2.

[Kohler J](#), [Kern U](#), [Kasper J](#), [Rhesse-Küpper B](#), [Thoden U](#) (1988) Chronic central nervous system involvement in Lyme borreliosis. Neurology. 38(6), 863-7.

[Ackermann R](#), [Rehse-Kupper B](#), [Gollmer E](#), [Schmidt R](#) (1988) [Chronic neurologic manifestations of erythema migrans borreliosis.](#) Ann N Y Acad Sci. 539, 16-23.

[Logigian EL](#), [Kaplan RF](#), [Steere AC](#) (1990) [Chronic neurologic manifestations of Lyme disease.](#) N Engl J Med. 323(21), 1438-44.

[Gila L](#), [Guerrero A](#), [Astarloa R](#), [Martí P](#), [Gutiérrez JM](#) (1990) Reflex sympathetic dystrophy. A new manifestation of Lyme disease? [Enferm Infecc Microbiol Clin.](#) 8(1), 32-5. [Article in Spanish]  
<http://www.ncbi.nlm.nih.gov/pubmed/2095902> Synonyme : Reflex Sympathetic Dystrophy, RSD, Complex

Regional Pain Syndrome Type 1, CRPS, Reflex

[Fühere Bezeichnungen, die heute nicht mehr verwendet werden sollen: Reflexdystrophie, Morbus Sudeck, Sudeck Dystrophie, Algodystrophie, sympathische Reflexdystrophie]

„Antigen-antibody bands were detected in increasing number during the evolution, using sonicates of B. burgdorferi and patient's sera with the Western blotting technique. Our data suggest that reflex sympathetic dystrophy is another type of nervous system involvement in the multifaceted Lyme borreliosis“.

[Krupp LB](#), [Masur D](#), [Schwartz J](#), [Coyle PK](#), [Langenbach LJ](#), [Fernquist SK](#), [Jandorf L](#), [Halperin JJ](#) (1991)



[Cognitive functioning in late Lyme borreliosis.](#) Arch Neurol. 48(11), 1125-9.

Krüger H, Heim E, Schuknecht B, Scholz S. (1991) [Acute and chronic neuroborreliosis with and without CNS involvement: a clinical, MRI, and HLA study of 27 cases.](#) J Neurol. 238(5), 271-80.

Barnett W, Sigmund D, Roelcke U, Mundt C (1991) [Endogenous paranoid-hallucinatory syndrome caused by Borrelia encephalitis.](#) Nervenarzt 62(7), 445-7 [German]

Pfister HW, Preac-Mursic V, Wilske B, Rieder G, Forderreuther S, Schmidt S, Kapfhammer HP (1993) Catatonic syndrome in acute severe encephalitis due to Borrelia burgdorferi infection. Neurology. 43(2), 433-5.

[Horneff G, Huppertz HI, Müller K, Voit T, Karch H \(1993\) Demonstration of Borrelia burgdorferi infection in a child with Guillain-Barré syndrome. Eur J Pediatr. 152\(10\), 810-2.](#)  
<http://www.ncbi.nlm.nih.gov/pubmed/8223782?dopt=Abstract>

Gutknecht J, De Wazières B, Fest T, Dupond JI (1994) Guillain-Barre syndrome associated with Lyme disease [Presse Medicale \(Paris, France : 1983\)](#) 23(10), 490 <http://europepmc.org/abstract/med/8022727>

Dekonenko EP, Umanskii KG, Virich IE, Kupriianova LV, Rudometov, IuP, Bagrov FI (1995) The basic syndromes of neurological disorders in Lyme borreliosis. Ter Arkh 67 (11), 52-53

Caliendo MV, Kushon DJ, Helz JW (1995) [Delirium and Lyme disease.](#) Psychosomatics. 36(1), 69-74.

Kobayashi K, Mizukoshi C, Aoki T, Muramori F, Hayashi M, Miyazu K, Koshino Y, Ohta M, Nakanishi I, Yamaguchi N (1997) [Borrelia burgdorferi-seropositive chronic encephalomyelopathy: Lyme neuroborreliosis? An autopsied report.](#) Dement Geriatr Cogn Disord. 8(6), 384-90.

Corral I, Quereda C, Guerrero A, Escudero R, Marti-Belda P (1997) NEUROLOGICAL MANIFESTATIONS IN PATIENTS WITH SERA POSITIVE FOR BORRELIA BURGDORFERI Neurologia 12(1), 2-8  
<http://www.ncbi.nlm.nih.gov/pubmed/9131908>

Riedel M, Straube A, Schwarz MJ, Wilske B, Muller N (1998) Lyme disease presenting as Tourette's syndrome. Lancet. 351(9100), 418-9

Shetty T, Shetty T, Shapiro EE (1998) GUILLAIN-BARRÉ SYNDROME IN A CHILD WITH SEROLOGIC EVIDENCE OF BORRELIA BURGDORFERI INFECTION. Pediatric Infectious Disease Journal: [17\(3\) 264-265](#) Q & A.  
[http://journals.lww.com/pidj/Citation/1998/03000/GUILLAIN\\_BARR\\_SYNDROME\\_IN\\_A\\_CHILD\\_WITH\\_SEROLOGIC.25.aspx](http://journals.lww.com/pidj/Citation/1998/03000/GUILLAIN_BARR_SYNDROME_IN_A_CHILD_WITH_SEROLOGIC.25.aspx)

Pollina DA, Sliwinski M, Squires NK, Krupp LB (1999) [Cognitive processing speed in Lyme disease.](#) Neuropsychiatry Neuropsychol Behav Neurol. 12(1), 72-8.

Bransfield RC (1999) Case Report: Lyme Disease and Complex Partial Seizures. Journal of Spirochetal and Tick-Borne Diseases. 6(3), 123-125.

Bransfield RC (2017) Infections sometimes cause violence, but to what extent? Literature and chart reviews. Rutgers-RWJ Medical School, New Jersey, USA ILADS Paris, France

Bransfield RC (2018) Aggressiveness, violence, homicidality, homicide, and Lyme disease. DovePress. [2018, 14](#), 693-713 [https://www.dovepress.com/articles.php?article\\_id=37144](https://www.dovepress.com/articles.php?article_id=37144)

[Bransfield RC \(2018\) Neuropsychiatric Lyme Borreliosis: An Overview with a Focus on a Specialty Psychiatrist's Clinical Practice. Healthcare 6\(3\), 104; https://doi.org/10.3390/healthcare6030104](#)  
<http://www.mdpi.com/2227-9032/6/3/104>

Hess A, Buchmann J, Zettl UK, Henschel S, Schlaefke D, Grau G, Benecke R. (1999) [Borrelia burgdorferi central nervous system infection presenting as an organic schizophrenialike disorder.](#) Biol Psychiatry 45(6), 795

[Faul JL, Ruoss S, Doyle RL, Kao PN \(1999\) Diaphragmatic paralysis due to Lyme disease. Eur Respir J. 13\(3\), 700-2. http://www.ncbi.nlm.nih.gov/pubmed/10232450](#)

Tager FA, Fallon BA, Keilp J, Rissenberg M, Jones CR, Liebowitz MR (2001) A Controlled Study of Cognitive Deficits in Children With Chronic Lyme Disease. J Neuropsychiatry Clin Neurosci 13, 500-507  
<http://www.lymediseaseassociation.org/Tager.pdf>

Poplawska R, Konarzewska B, Gudiel-Trochimowicz I, Szulc A (2001) [Psychologic disorders in acute and persistent neuroborreliosis.](#) Pol Merkuriusz Lek 10(55), 36-7

Newberg A, Hassan A, Alavi A (2002) [Cerebral metabolic changes associated with Lyme disease](#) Nucl Med Commun 23(8), 773-777

Cowley G, Underwood A (2004) [A disease in disguise. Lyme can masquerade as migraine, or as madness.](#) Newsweek. 144(8), 62.

[Abbott RA, Hammans S, Margaron M, Aji BM \(2005\) Diaphragmatic paralysis and respiratory failure as a complication of Lyme disease. J Neurol Neurosurg Psychiatry. 76\(9\), 1306-7.](#)  
<http://www.ncbi.nlm.nih.gov/pubmed/16107377>

Hájek T, Libiger J, Janovská D, Hájek P, Alda M, Höschl C (2006) [Clinical and demographic characteristics of psychiatric patients seropositive for Borrelia burgdorferi.](#) Eur Psychiatry. 21(2), 118-22.

Créange A (2007) [Clinical manifestations and epidemiological aspects leading to a diagnosis of Lyme borreliosis: neurological and psychiatric manifestations in the course of Lyme borreliosis.](#) Med Mal Infect.

37(7-8), 532-9. Review. French.

Chabria SB, Lawrason J. (2007) [Altered mental status, an unusual manifestation of early disseminated Lyme disease: A case report](#). *J Med Case Reports*. 9(1), 62.

Gustaw-Rothenberg K (2008) Cognitive Impairments after Tick-borne Encephalitis. *Dementia and Geriatric Cognitive Disorders*. 26, 165-168.

[Chandra A](#), [Wormser GP](#), [Klempner MS](#), [Trevino RP](#), [Crow MK](#), [Latov N](#), [Alaedini A](#). (2010)

Anti-neural antibody reactivity in patients with a history of Lyme borreliosis and persistent symptoms. [Brain Behav Immun](#). 24(6), 1018-24. doi:10.1016/j.bbi.2010.03.002. Epub 2010 Mar 18.

<http://www.ncbi.nlm.nih.gov/pubmed/20227484>

[Karosi T](#), [Rácz T](#), [Szekanecz E](#), [Tóth A](#), [Sziklai I](#) (2010) Recurrent laryngeal nerve paralysis due to subclinical Lyme borreliosis. [J Laryngol Otol](#). 124(3), 336-8. doi: 10.1017/S0022215109990867. Epub 2009 Sep 10.

<http://www.ncbi.nlm.nih.gov/pubmed/19740453>

[Markeljevi J](#), [Sarac H](#), [Rados M](#) (2011) Tremor, Seizures and Psychosis as Presenting Symptoms in a Patient with Chronic Lyme Neuroborreliosis (Lnb). *Coll. Antropol*. 35 Suppl. 1, 313–318 Case report

[Miklossy J](#) (2012) Chronic or late lyme neuroborreliosis: analysis of evidence compared to chronic or late neurosyphilis. *Open Neurol J* 6, 146-57.

[Ibrahim M](#), [Binalsheikh IM](#), [David Griesemer D](#), [Sonya Wang S](#), [Rebeca Alvarez-Altalef R](#) (2012) Lyme Neuroborreliosis Presenting as Alice in Wonderland Syndrome. *Pediatric Neurology*. 46(3), 185-186

[Sinclair L](#) (2013) Case Shows How Lyme Disease Can Mimic New-Onset Panic Disorder. *Psychiatric News*. 48(13), 1 DOI:10.1176/appi.pn.2013.6b19

<http://psychnews.psychiatryonline.org/newsarticle.aspx?articleid=1700960>

[Martínez-Balzano CD](#), [Greenberg B](#) (2014) Bilateral vocal cord paralysis requiring tracheostomy due to neuroborreliosis. [Chest](#). 146(5), e153-5. doi: 10.1378/chest.14-0515.

<http://www.ncbi.nlm.nih.gov/pubmed/25367481>

[Puri BK](#), [Shah M](#), [Monro JA](#), [Kingston MC](#), [Julu PO](#) (2014) Respiratory modulation of cardiac vagal tone in Lyme disease. [World J Cardiol](#). 6(6), 502-6. doi: 10.4330/wjc.v6.i6.502.

<http://www.ncbi.nlm.nih.gov/pubmed/24976922>

[Sokolov AA](#), [Lienhard R](#), [Du Pasquier R](#) et al. (2015) Acute Lyme Neuroborreliosis With Transient Hemiparesis and Aphasia. *Annals of Emergency Medicine*

DOI: <http://dx.doi.org/10.1016/j.annemergmed.2015.01.011>

<http://www.annemergmed.com/article/S0196-0644%2815%2900028-1/abstract>

[Gampourou F](#), [Taithe F](#), [Moisset X](#), [Clavelou P](#) (2015) Seronegative Lyme neuroborreliosis in a patient treated by rituximab. [Rev Neurol \(Paris\)](#). pii: S0035-3787(15)00794-8. doi: 10.1016/j.neurol.2015.06.009.

<http://www.ncbi.nlm.nih.gov/pubmed/26318890>

[Ebner D](#), [Smith K](#), [DeSimone D](#), [Sohail MR](#) (2018) Cranial neuropathy and severe pain due to early disseminated *Borrelia burgdorferi* infection. [BMJ Case Rep](#). 2018. pii: bcr-2017-223307. doi: 10.1136/bcr-2017-223307.

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## [2.12.10](#) ADHS and psychiatric patients

### Immunosystem

[Bransfield RC](#) (2012) The Psychoimmunology of Lyme/Tick-Borne Diseases and its Association with Neuropsychiatric Symptoms. *The Open Neurology Journal* 6 (Suppl 1-M3) 88-93

<http://www.ncbi.nlm.nih.gov/pubmed/23091569>

<http://beyondthebandaid.com.au/wp-content/uploads/2012/07/The-Psychoimmunology-of-Tick-Borne-Diseases-its-Association-with-Neuropsychiatric-Symptoms.pdf>

[Bransfield RC](#) (2012) Relationship of Inflammation and Autoimmunity to Psychiatric Sequelae in Lyme Disease. *Psychiatric Annals* , 337-341

[http://www.ilads.org/ilads\\_news/2012/relationship-of-inflammation-and-autoimmunity-to-psychiatric-sequelae-in-lyme-disease/](http://www.ilads.org/ilads_news/2012/relationship-of-inflammation-and-autoimmunity-to-psychiatric-sequelae-in-lyme-disease/)

[Bechter K](#). (2013) Schizophrenia - a Mild Encephalitis? *Fortschr Neurol Psychiatr*. 2013 Apr 29.

<http://www.ncbi.nlm.nih.gov/pubmed/23629631>

"With the ME model connected is a set of three contributing factors: genes, environment (especially infectious agents) and the immune system".

[Stich O](#), [Andres TA](#), [Gross CM](#), [Gerber SI](#), [Rauer S](#), [Langosch JM](#). (2014) An observational study of inflammation in the central nervous system in patients with bipolar disorder. [Bipolar Disord](#).

doi:10.1111/bdi.12244. [Epub ahead of print] <http://www.ncbi.nlm.nih.gov/pubmed/25109751>

[Avramopoulos D, Pearce BD, McGrath J](#) (2015) Infection and inflammation in schizophrenia and bipolar disorder: a genome wide study for interactions with genetic variation. [PLoS One](#). 10(3), e0116696. doi: 10.1371/journal.pone.0116696. eCollection 2015. <http://www.ncbi.nlm.nih.gov/pubmed/25781172>  
[Gacias M, Gaspari S, Mae-Santos P](#) et al. (2016) Microbiota-driven transcriptional changes in prefrontal cortex override genetic differences in social behavior. [eLife](#). 5. pii: e13442. doi: 10.7554/eLife.13442. [Epub ahead of print] <http://www.ncbi.nlm.nih.gov/pubmed/27097105>

„Our results thus demonstrate that the gut microbiota modifies the synthesis of key metabolites affecting gene expression in the prefrontal cortex, thereby modulating social behavior“.

[Alam R, Abdolmaleky HM, Zhou JR](#) (2017) Microbiome, inflammation, epigenetic alterations, and mental diseases. *Am J Med Genet B Neuropsychiatr Genet*. 174(6) 651-660. doi:10.1002/ajmg.b.32567. Epub 2017 Jul 10. <https://www.ncbi.nlm.nih.gov/pubmed/28691768>

[https://www.researchgate.net/publication/318326255\\_Microbiome\\_inflammation\\_epigenetic\\_alterations\\_and\\_mental\\_diseases](https://www.researchgate.net/publication/318326255_Microbiome_inflammation_epigenetic_alterations_and_mental_diseases)

“In this review we will consider the potential interactions of diet, gastrointestinal microbiome, inflammation, and epigenetic alterations in psychiatric disorders”.

[Weber NS, Gressitt KL, Cowan DN](#) et al. (2017) Monocyte activation detected prior to a diagnosis of schizophrenia in the US Military New Onset Psychosis Project (MNOPP). *Schizophrenia research*. [http://www.schres-journal.com/article/S0920-9964%2817%2930768-5/abstract#.WIRsvC66oO8\\_blogger](http://www.schres-journal.com/article/S0920-9964%2817%2930768-5/abstract#.WIRsvC66oO8_blogger)

[Abbott A](#) (2018) Depression: the radical theory linking it to inflammation. *Nature*. Books and Arts. <https://www.nature.com/articles/d41586-018-05261-3>

### Viruses

[Arias I, Sorlozano A, Villegas E](#) et al. (2012) Infectious agents associated with schizophrenia: A meta-analysis. [Schizophr Res](#). 136(1-3), 128-36. doi: 10.1016/j.schres.2011.10.026. Epub 2011 Nov 21. <https://www.ncbi.nlm.nih.gov/pubmed/22104141>

[Coughlin SS](#) (2012) Anxiety and Depression: Linkages with Viral Diseases. [Public Health Rev](#). Author manuscript; available in PMC 2014 Sep 26. Published in final edited form as: *Public Health Rev*. 2012; 34(2), 92. PMID: PMC4175921 NIHMSID: NIHMS407997 PMID: [25264396](#)  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4175921/>

[Bechter K](#) (2013) Virus Infection as a Cause of Inflammation in Psychiatric Disorders. [Halaris A, Leonard BE](#) (eds): *Inflammation in Psychiatry. Mod Trends Pharmacopsychiatry*. Basel, Karger, 2013, vol 28, pp 49–60 (DOI: 10.1159/000343967)

[https://www.karger.com/ProdukteDB/Katalogteile/isbn3\\_318/\\_023/\\_10/343967\\_p49-52.pdf](https://www.karger.com/ProdukteDB/Katalogteile/isbn3_318/_023/_10/343967_p49-52.pdf)

[https://www.researchgate.net/publication/265690816\\_Virus\\_Infection\\_as\\_a\\_Cause\\_of\\_Inflammation\\_in\\_Psychiatric\\_Disorders](https://www.researchgate.net/publication/265690816_Virus_Infection_as_a_Cause_of_Inflammation_in_Psychiatric_Disorders)

[Mazaheri-Tehrani E, Maghsoudi N, Shams J](#) (2014) Borna disease virus (BDV) infection in psychiatric patients and healthy controls in Iran. [Virol J](#). 11(1), 161. [Epub ahead of print] <http://www.ncbi.nlm.nih.gov/pubmed/25186971>

### Bacteria

[Kohler J](#). (1990) [Lyme borreliosis in neurology and psychiatry](#) *Fortschr Med*. 108(10),191-3,197.

[Rundell JR, Wise MG](#). (1985) Neurosyphilis: a psychiatric perspective. *Psychosomatics* 26, 287-295. <http://www.ncbi.nlm.nih.gov/pubmed/3887454>

[Fallon BA, Nields JA, Burrascano JJ, Liegner K, DeBene D, Liebowitz MR](#) (1992) [The neuropsychiatric manifestations of Lyme borreliosis](#). *Psychiatr Q*. 63(1) , 95-117. Review <http://www.lymenet.org>

[Fallon BA, Nields JA, Parsons B, Liebowitz MR, Klein DF](#) (1993) [Psychiatric manifestations of Lyme borreliosis](#). *J Clin Psychiatry*. 54(7), 263-8.

[Fallon BA, Nields JA](#). (1994) Lyme disease: a neuropsychiatric illness. *Am J Psychiatry*. 151(11), 1571-83. <http://www.ncbi.nlm.nih.gov/pubmed/7943444> <http://www.angelfire.com/biz/romarkaraoke/lymeart.html>

[Fallon BA, Bird H, Hoven C, Cameron D, Liebowitz MR, Shaffer D](#). (1994) Psychiatric aspects of Lyme disease in children and adolescents: A community epidemiologic study in Westchester, New York. *Journal of Tick Borne and Spirochetal Diseases*, 1, 98-100

[Fallon BA](#). (1995) Neuropsychiatric Lyme Disease. *Harvard Mental Health Letter*, Forum 10/95

[Fallon BA, Schwartzberg M, Bransfield R, Zimmerman B, Scotti A, Weber CA, Liebowitz MR](#). (1995) Late-stage neuropsychiatric Lyme borreliosis. Differential diagnosis and treatment. *Psychosomatics*. 36(3), 295-300

[Fallon BA, Das S, Plutchok J, Tager F., Liegner K, Van Heertum R](#) (1997) Functional imaging and neuropsychological testing in Lyme disease. *Clinical Infectious Diseases*, 25, S57-63

[Fallon BA, Kochevar JM, Gaito A, Nields JA](#). (1998) [The Underdiagnosis of Neuropsychiatric Lyme Disease in Children and Adults](#) *Psychiatric Clinics of North America*, 21, 693-703 <http://www.lymenet.org>

[Fallon BA](#). (2000) Neuropsychiatric Aspects of Non-HIV Infectious Diseases. In *Comprehensive Textbook of Psychiatry*, Seventh Edition. Ed. Kaplan and Sadock. Williams and Wilkins.

[Fallon B et al](#). (2003) [Regional Cerebral Blood Flow and Cognitive Deficits in Chronic Lyme Disease](#). *J Neuropsychiatry Clin Neurosci* 15, 326-332

Fallon B (2004) Neuropsychiatric Lyme Disease: the New 'Great Imitator' *Psychiatric Times*

Fallon BA, Vaccaro B, Romano M, Clemente D. (2006) Neuropsychiatric and Neuropathologic Aspects of Lyme Disease. *Psychiatric Annals*, 36,120-128

Fallon BA (2006) Mystery Diagnosis: treatment of Neuropsychiatric Lyme Disease. In *DSM-IV-TR Case Book: Experts Tell how they treated their own patients, Volume 2*. Ed. Spitzer RL, First MB, Williams JBW, Gibbon M. American Psychiatric Publishing, Inc. pp 39-52.

Barnett W, Sigmund D, Roelcke U, Mundt C. (1991) [Endogenous paranoid-hallucinatory syndrome caused by Borrelia encephalitis](#) *Nervenarzt* 62(7), 445-7

Pfister HW, Preac-Mursic V, Wilske B, Rieder G, Forderreuther S, Schmidt S, Kapfhammer HP (1993) Catatonic syndrome in acute severe encephalitis due to *Borrelia burgdorferi* infection. *Neurology*. 43(2), 433-5. <http://www.ncbi.nlm.nih.gov/pubmed/8437717>

van den Bergen HA, Smith JP, van der Zwan A. (1993) [Lyme Psychosis](#) *Ned Tijdschr Geneesk* 137(41), 2098-100

Stein SL, Solvason HB, Biggart E, Spiegel D. (1996) [A 25-year-old woman with hallucinations, hypersexuality, nightmares, and a rash](#). *Am J Psychiatry*. 153(4), 545-51.

Nadelman RB, Herman E, Wormser GP. (1997) [Screening for Lyme disease in hospitalized psychiatric patients: prospective serosurvey in an endemic area](#). *Mt Sinai J Med*. 64(6), 409-12.

"Sera from only 1 of 517 patients demonstrated antibodies to *Borrelia burgdorferi*, the etiologic agent of Lyme disease (0.2% [95% CI, 0.0% to 1.1%]). This patient had a nonreactive Western blot, which suggested a false-positive antibody test."

Liegner KI, Duray P, Agricola M, Fosenkilde C, Iannuzzi L, Ziska M, Tilton R, Hulinska D, Hubbard J, Fallon B (1998) Lyme disease and the clinical spectrum of antibiotic-responsive meningoencephalomyelitides. *Journal of Spirochetal and Tick Borne Diseases*. 4, 62-73.

Paparone PW (1998) [Neuropsychiatric manifestations of Lyme disease](#) *J Am Osteopath Assoc* 98(7), 373-8

Hess A, Buchmann J, Zettl UK, Henschel S, Schlaefke D, Grau G, Benecke R. (1999) [Borrelia burgdorferi central nervous system infection presenting as an organic schizophrenialike disorder](#). *Biol Psychiatry* 45(6), 795

Battaglia H, Alvarez G, Mercau A, Fay M, Campodonico M.(2000) Psychiatric symptomatology associated with presumptive Lyme disease: Clinical evidence. *Journal of Spirochetal and Tick-Borne Diseases* 1-6.

Sherr VT. (2000) [Panic Attacks May Reveal Previously Unsuspected Chronic Disseminated Lyme Disease](#) *Journal of Psychiatric Practice*, 6, 352-356

Tager FA, Fallon BA, Rissenberg M, Jones CR, Liebowitz MR (2001) A controlled study of cognitive deficits among children with chronic Lyme disease. *J Neuropsychiatry* 13, 500-507.

Fritzsche M. (2002) [Seasonal correlation of sporadic schizophrenia to Ixodes ticks and Lyme borreliosis](#) *International Journal of Health Geographics* 1, 2  
<http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pubmed&pubmedid=12453316>

Hajek T, Paskova B, Janovska D, Bahbouh R, Hajek P, Libiger J, Hoschl C. (2002) [Higher prevalence of antibodies to Borrelia burgdorferi in psychiatric patients than in healthy subjects](#), *Am J Psychiatry*. 159(2), 297-301. ([free full text](#))

"These findings support the hypothesis that there is an association between *Borrelia burgdorferi* infection and psychiatric morbidity. In countries where this infection is endemic, a proportion of psychiatric inpatients may be suffering from neuropathogenic effects of *Borrelia burgdorferi*".

Stricker R, Winger (2003) [Musical Hallucinations in Patients with Lyme Disease](#) *Southern Medical Journal* 96(7), 711-715

Bar KJ, Jochum T, Hager F, Meissner W, Sauer H. (2005) [Painful hallucinations and somatic delusions in a patient with the possible diagnosis of neuroborreliosis](#). *Clin J Pain*. 21(4), 362-3.

Bransfield RC, Wulfman JS, Harvey WT, Usman AI. (2007) [The association between tick-borne infections, Lyme borreliosis and autism spectrum disorders](#) *Medical Hypotheses*. 70(5), 967-974  
[https://www.ncbi.nlm.nih.gov/pubmed/17980971?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed\\_ResultsPanel.Pubmed\\_DefaultReportPanel.Pubmed\\_RVDocSum](https://www.ncbi.nlm.nih.gov/pubmed/17980971?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum)

Bransfield RC. (2007) [Lyme Disease, Comorbid Tick-Borne Diseases, and Neuropsychiatric Disorders](#) *Psychiatric Times*. 24(14)

Bransfield, R. (2008). Lyme, depression, and suicide. Retrieved January 3, 2008, from [http://www.lymealliance.org/bransfield/bransfield\\_3.php](http://www.lymealliance.org/bransfield/bransfield_3.php)

Bransfield RC (2009) Preventable cases of autism: relationship between chronic infectious diseases and neurological outcome. *Psychiatric Health* 3(2), 125-140, DOI 10.2217/phe.09.5 (doi:10.2217/phe.09.5)

«There is evidence that chronic infections and the immune reactions associated with them may contribute to causing autism spectrum disorders. These infections include Babesia, Bartonella, *Borrelia burgdorferi*, Ehrlichia, Human herpesvirus-6, Chlamydia pneumoniae and Mycoplasma (in particular *Mycoplasma fermentans*). «

Bransfield RC (2012) The Psychoimmunology of Lyme/Tick-Borne Diseases and its Association with Neuropsychiatric Symptoms. *The Open Neurology Journal* 6 (Suppl 1-M3) 88-93



<http://www.ncbi.nlm.nih.gov/pubmed/23091569>

<http://beyondthebandaid.com.au/wp-content/uploads/2012/07/The-Psychoimmunology-of-Tick-Borne-Diseases-its-Association-with-Neuropsychiatric-Symptoms.pdf>

Bransfield RC (2012) [Can infections and immune reactions to them cause violent behavior?](#)

Abstracts of 11th Psychoimmunology Expert Meeting. Neurology, Psychiatry and Brain Research. 18(2), 42

Bransfield R. (2013) The Neuropsychiatric Assessment of Lyme Disease. [www.mentalhealthandillness.com/tnaold.html](http://www.mentalhealthandillness.com/tnaold.html)

<http://www.anapsid.org/lyme/bransfield-neuropsych.pdf>

Bransfield RC (2015) Chronic Infections as Aetiological Factors in Psychiatric Disorders. 21st Annual International Integrative Medicine Conference Melbourne Australia.

[http://www.researchgate.net/publication/280386410\\_Chronic\\_Infections\\_as\\_Aetiological\\_Factors\\_in\\_Psychiatric\\_Disorders](http://www.researchgate.net/publication/280386410_Chronic_Infections_as_Aetiological_Factors_in_Psychiatric_Disorders)

Bransfield RC (2015) Inflammation in Chronic Brain Diseases. 21st Annual International Integrative Medicine Conference Melbourne Australia.

[http://www.researchgate.net/publication/280386580\\_Inflammation\\_in\\_Chronic\\_Brain\\_Diseases](http://www.researchgate.net/publication/280386580_Inflammation_in_Chronic_Brain_Diseases)

Bransfield RC (2016) Are There Psychoimmune and Infectious Contributors to Violence? New Jersey Psychiatric Association Central Chapter Meeting. Princeton, NJ, DOI: 10.13140/RG.2.2.33357.84968.

Bransfield R (2018) Lyme/Tick-borne Disease and Mental Illness Workshop NASW-MD Chapter Conference Paper [https://www.researchgate.net/publication/329681919\\_LymeTick-borne\\_Disease\\_and\\_Mental\\_Illness\\_Workshop\\_NASW-MD\\_Chapter](https://www.researchgate.net/publication/329681919_LymeTick-borne_Disease_and_Mental_Illness_Workshop_NASW-MD_Chapter)

Scheffer RE, Linden S. (2007) [Concurrent medical conditions with pediatric bipolar disorder.](#) Curr Opin Psychiatry. 20(4), 398-401. Review.

Legatowicz-Koprowska M, Gziut AI, Walczak E, Gil RJ, Wagner T (2008) [\[Borreliosis--simultaneous Lyme carditis and psychiatric disorders--case report\]](#) Pol Merkur Lekarski. 24(143), 433-5.

Duncan T, Rosner B (2008) The Lyme-Autism Connection: Unveiling the Shocking Link Between Lyme Disease and Childhood Developmental Disorders.

<http://www.amazon.com/gp/product/0976379759?ie=UTF8&tag=lymeinfo-20&linkCode=as2&camp=1789&creative=9325&creativeASIN=0976379759>

Fellerhoff B, Wank R. (2011) Increased prevalence of Chlamydomyces DNA in post-mortem brain frontal cortex from patients with schizophrenia. [Schizophr Res.](#) 129(2-3), 91-5. doi: 10.1016/j.schres.2011.04.015. Epub 2011 May 5. <https://www.ncbi.nlm.nih.gov/pubmed/21546214>

„Persistent Chlamydomyces-infected microglia or neuronal cells may impair neuronal circuits and thus be a mechanism for causing psychiatric illness in these patients.“

Pasareanu AR, Mygland Å, Kristensen Ø. (2012) A woman in her 50s with manic psychosis. Tidsskr Nor Lægeforen. 132(5), 537-9

Banerjee R, Liu JJ, Minhas HM (2013) Lyme Borreliosis Presenting with Alexithymia and Suicide Attempts. Case Report. J.Clin Psychiatry 74,10

<http://relative-risk.blogspot.de/2013/11/an-unusual-case-presentation.html>

Rosner B (2014) Lyme Disease and Mental Illness

<http://www.lymebook.com/lyme-disease-mental-illness-schizophrenia-bipolar-ocd>

Ribeiro FM, Signorelli F (2017) The role of infections in neuropsychiatric lupus. [Lupus.](#) 26(5), 490-496. doi: 10.1177/0961203317691375. <https://www.ncbi.nlm.nih.gov/pubmed/28394236>

### **Protozoa**

Varney NR, Roberts RJ, Springer JA, Connell SK, Wood PS. (1997) Neuropsychiatric sequelae of cerebral malaria in Vietnam veterans. J Nerv Ment Dis. 185(11), 695-703

Dugbartey AT, Dugbartey MT, Apedo MY. (1998) Delayed neuropsychiatric effects of malaria in Ghana. J Nerv Ment Dis. 186(3), 183-186

Thiam MH, Diop BM, Dieng Y, Gueye M. (2002) Mental disorders in cerebral malaria [French]. Dakar Med. 47(2), 122-127

Markovitz A, Simanek AM, Yolken R, Galea S, Koenen KC, Chen S, Aiello AE (2014) Toxoplasma gondii and anxiety disorders in a community-based sample. DOI:10.1016/j.bbi.2014.08.001 Brain, Behavior, and Immunity. Available online 12 August 2014 <http://www.sciencedirect.com/science/article/pii/S0889159114004188>

### **Neurocysticercosis, nematodae, filariae**

Huismans H (1979) Tierische Parasiten des menschlichen Auges. Bücherei des Augenarztes ENKE Heft 80 <http://katalog.ub.uni-heidelberg.de/cgi-bin/titel.cgi?katkey=66347375>

Wallin MT, Kurtzke JF. (2004) Neurocysticercosis in the United States: review of an important emerging infection. Neurology. 63(9), 1559-1564

Mahajan SK, Machhan PC, Sood BR, et al. (2004) Neurocysticercosis presenting with psychosis. J Assoc Physicians India. 52, 663-665

García HH, Evans CAW, Nash TE (2013) Current Consensus Guidelines for Treatment of Neurocysticercosis. <http://cmr.asm.org/content/15/4/747.full>

### **Mycoses, Fungi**

Severance EG, Gressitt KL, Stallings CR et al. (2016) Candida albicans exposures, sex specificity and cognitive deficits in schizophrenia and bipolar disorder. *npj Schizophrenia*, 2, 16018 DOI: 10.1038/npjSchz.2016.18 <http://www.nature.com/articles/npjSchz201618>

"In conclusion, sex-specific *C. albicans* immune responses were evident in psychiatric disorder subsets. Inquiry regarding *C. albicans* infection or symptoms may expedite amelioration of this treatable comorbid condition".

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## Rheumatologic, pneumologic, gastroenterologic Diagnoses

### 2.12.11 Arthritis

#### Immunosystem

Wen H, Baker JF (2011) Vitamin D, immunoregulation, and rheumatoid arthritis. *Journal of clinical rheumatology: practical reports on rheumatic & musculoskeletal diseases*.17(2), 102

[Scher JU](#), [Ubeda C](#), [Artacho A](#) (2015) Decreased bacterial diversity characterizes the altered gut microbiota in patients with psoriatic arthritis, resembling dysbiosis in inflammatory bowel disease. *Arthritis Rheumatol.* 67(1), 128-39. doi: 10.1002/art.38892. <http://www.ncbi.nlm.nih.gov/pubmed/25319745>

Catrina AI, Deane KD, Scher JU (2016) Gene, Environment, Microbiome and Mucosal Immune Tolerance in Rheumatoid Arthritis. *Rheumatology*. 55(3), 391-402. doi: 10.1093/rheumatology/keu469. <https://www.ncbi.nlm.nih.gov/pubmed/25539828>

«RA is a complex multifactorial chronic disease that transitions through several stages. ... In discussing this hypothesis, we will present herein the current understanding of mucosal immunology, including a discussion about the generation of autoimmune responses at these surfaces. We will also examine how other factors such as genes, microbes and other environmental toxins (including tobacco smoke) could influence the triggering of autoimmunity at mucosal sites and eventually systemic organ disease«.

#### Viruses

Warren SK, Marmor L, Liebes DM et al (1969) An active agent from human rheumatoid arthritis with ist transmissible in mice. *Arch. Intern. Med.* 124, 629-634

Warren SK, Marmor L, Liebes DM et al (1969) Congenital transmission in mice of an active agent from human rheumatoid arthritis. *Nature* 223, 646-664

Warren SK, Marmor L, Boak R et al. (1971) Transmission of an active agent from rheumatoid arthritis synovial tissue to chicks, *Arch. Intern. Med.* 128, 619-622

Warren SK, Marmor L, Liebes DM et al. (1972) An active agent from rheumatoid arthritis synovial tissue. *Arch. Intern. Med.* 130, 899-903 <http://archinte.jamanetwork.com/article.aspx?articleid=580389>

"The agent in rheumatoid arthritis (RA) synovial tissue has been transmitted from individual patients to normal mice and rats by injection or ingestion. There was a variation in degree of the severity of the characteristic acute lesions in mice induced by the tissue of each individual patient. Similar characteristic lesions were induced in the same manner from RA-affected mouse and rat tissues. Neither injection nor ingestion of normal tissues induced lesions".

Warren SK, Marmor L, Stamm ME et al. (1975) Thermal inactivation and gradient studies of the active agent in rheumatoid arthritis. *Rheumatology* 6, 361-367

Warren SK, Marmor L, Horner HE et al. (1979) Further studies on the specific infectious agent isolated in rheumatoid arthritis. *J. Rheumatol.* 6, 135-146

Warren SK, Marmor L, Gerken SC et al. (1979) Correlation of a bioassay with the clinical status of patients with rheumatoid arthritis. *Clin. Orthopaed.* 144, 299-304

Schumacher HR Jr. (1975) Synovial membrane and fluid morphologic alterations in early rheumatoid arthritis: microvascular injury and virus-like particles. *Ann. N.Y. Acad.* 256, 39-64

Godzeski CW, Boyd R, Snith CA et al (1978) Viral-like particles in cocultivated rheumatoid synovial cells. *Arthrit. Rheum. Abstr.* 21, 559

Simpson RW, McGinty L, Simon L et al. (1984) Association of parvoviruses with rheumatoid arthritis of humans. *Science* 233, 1425-1428

Cohen BJ, Buckley MM, Clewley JP et al (1986) Human parvovirus infection in early rheumatoid and inflammatory arthritis. *Ann. Rheum. Dis.* 45, 832-838

Lovy MR, Starkebaum G, Uberoi S (1996). Hepatitis C infection presenting with rheumatic manifestations: a mimic of rheumatoid arthritis. *J. Rheumatol* 23 (6), 1238–9.

Wollenhaupt J, Sieper J (1997) Erreger- und Infektorientierte Differentialdiagnostik der reaktiven Arthritiden. *Microbiological Procedures for the Diagnosis of Reactive Arthritis.* *Akt Rheumatol* 22(5), 191-197 DOI: 10.1055/s-2008-1043655. © Georg Thieme Verlag KG Stuttgart · New York

Takahashi Y, Muray C, Shibata S et al. (1998) Human Parvovirus B19 as a causative agent for rheumatoid arthritis. *Proc. Natl. Acad. Sci. USA*, 7, 95(14), 8227-8232

Balandraud N, Roudier J, Roudier C (2004) Epstein-Barr virus and rheumatoid arthritis. *Autoimmun Rev* 3 (5), 362–7.

Alvarez-Lafuente R, Fernández-Gutiérrez B, de Miguel S et al. (2005). Potential relationship between herpes viruses and rheumatoid arthritis: analysis with quantitative real time polymerase chain reaction. *Ann. Rheum. Dis.* 64 (9), 1357–9. <http://ard.bmj.com/content/64/9/1357.abstract>

“Herpes viruses may have a role in RA, although alternative explanations are possible: (a) defects in cellular immunity in patients with RA may result in a relatively high viral load; (b) patients with RA may be more prone to infection/reactivation. The usefulness of monitoring the DNA viral load in patients with RA is questioned by these data”.

Shah N, Hülsmeier AJ, Hochhold N, Neidhart M, Gay S, Hennes T. (2014) Exposure to mimivirus collagen promotes arthritis. *J Virol.* 88(2), 838-45. doi: 10.1128/JVI.03141-13. Epub 2013 Oct 30. <http://www.ncbi.nlm.nih.gov/pubmed/24173233>

Zeana C, et al. (2016) Post-chikungunya rheumatic disorders in travelers after return from the Caribbean, *Travel Medicine and Infectious Disease* <http://dx.doi.org/10.1016/j.tmaid.2016.01.009>

**Bacteria**

Cook J, Fincham WJ, Lack CH (1969) Chronic arthritis produced by streptococci L-Forms. *J. Pathol.* 99, 283-297

Waitzkin L (1969) Latent *Corynebacterium acnes* infection of bone marrow. *N. Engl. J. Med.* 281, 1404-1405

Fraser KB, Shirodaria PV, Haire M et al. (1971) Mycoplasmas in cell cultures from rheumatoid synovial membranes. *J. Hyg.* 69, 17-25

Barthelemew LE, Nelson FR (1972) *Corynebacterium acnes* in rheumatoid arthritis. *Ann. Rheum. Dis.* 31, 28-33

LeBar WD, Mattman LH, Ross L (1975) Isolation of cell wall deficient *Mycobacterium tuberculosis* from a case of chronic arthritis. *Henry Ford Hosp. Med. J.* 23, 17-20

Denys GA (1981) Characteristics of wall deficient and classical forms of *Propionibacterium acnes* from rheumatoid arthritis. Ph. D. dissertation, Wayne State University, Detroit.

Malawista SE, Steere AC, Hardin JA (1984) Lyme disease: a unique human model for an infectious etiology of rheumatic disease. *Yale J Biol Med.* 57, 473–477

Wirostko E, Johnson L, Wirostko W et al. (1989) Juvenile rheumatoid arthritis inflammatory eye disease. Parasitization of ocular leucocytes by mollicute-like organisms. *J. Rheumatol.* 16, 1446-1453. <http://www.ncbi.nlm.nih.gov/pubmed/2600945>

“This report describes MLO parasitized lesional leukocytes in the inflammatory eye disease of 5 patients with JRA. Our results indicate that MLO caused the uveitis of these patients. The significance of these findings and rifampin treatment of MLO disease are discussed”.

Scerpella TA, Engber WD (1992) Chronic Lyme disease arthritis: Review of the literature and report of a case of wrist arthritis. *The Journal of Hand Surgery.* 17(3), 571-575 <http://www.sciencedirect.com/science/article/pii/036350239290373W>

Lichtman SN, Bachmann S, Munoz SR et al. (1993) Bacterial cell wall polymers (peptidoglycan-polysaccharide) cause reactivation of arthritis. *Infect Immun.* 61(11), 4645-53. <https://www.ncbi.nlm.nih.gov/pubmed/8406862> [https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwji-lqA9\\_TiAhVToVwKHWDxDNEQFjABegQIABAC&url=https%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fpmc%2Farticles%2FPMC281216%2Fpdf%2Fiai00023-0121.pdf&usq=AOvVaw1OKBT97qIG6sCtT\\_e6tFcO](https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwji-lqA9_TiAhVToVwKHWDxDNEQFjABegQIABAC&url=https%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fpmc%2Farticles%2FPMC281216%2Fpdf%2Fiai00023-0121.pdf&usq=AOvVaw1OKBT97qIG6sCtT_e6tFcO)

Scharr S, A Wahl, B Jurgens-Saathoff, M Mengel, HH Kreipe, Zeidler H (2002) Nodular fasciitis, erythema migrans, and oligoarthritis: manifestations of Lyme borreliosis caused by *Borrelia afzelii*. *Scan J Rheumatol* 31, 184-186.

Leirisalo-Repo M, Hannu T, Mattila L (2003) Microbial factors in spondyloarthropathies: insights from population studies. *Curr Opin Rheumatol.* 15, 408–12. [DOI PubMed](https://pubmed.ncbi.nlm.nih.gov/12500000/)

Zeidler H, Kuipers J, Kohler L (2004) Chlamydia-induced arthritis. *Curr Opin Rheumatol.* 16, 380–92. [DOI PubMed](https://pubmed.ncbi.nlm.nih.gov/15000000/)

Hsieh Y-F, Liu H-W, Hsu T-Ch et al. (2007) Serum Reactivity against *Borrelia burgdorferi* OspA in Patients with Rheumatoid Arthritis. *CLINICAL AND VACCINE IMMUNOLOGY* American Society for Microbiology. 14(11), 1437–1441.

Poehmann KE (1997 Dissertation, 4. Auflage 2012) Rheumatoid Arthritis: The Infection Connection. Sarori Press. <http://www.amazon.com/Rheumatoid-Arthritis-Infection-Connection-Targeting/dp/0961726865>

Müller KE (2012) Damage of Collagen and Elastic Fibres by *Borrelia burgdorferi* – Known and New Clinical and Histopathological Aspects. *Open Neurol J.* 6, 179–186. Published online 2012 Dec 31. doi: [10.2174/1874205X01206010179](https://doi.org/10.2174/1874205X01206010179) PMID: PMC3751012 Suppl 1 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3751012/>

Markowicz M, Ladstätter S, Schötter AM et al (2015) Oligoarthritis Caused by *Borrelia bavariensis*, Austria,

2014. CDC EID journal 21(6) [http://wwwnc.cdc.gov/eid/article/21/6/14-1516\\_article](http://wwwnc.cdc.gov/eid/article/21/6/14-1516_article)  
Arvikar SL, Crowley JT, Sulka KB, Steere AC (2017) Autoimmune arthritides, rheumatoid arthritis, psoriatic arthritis, or peripheral spondyloarthropathy, following Lyme disease. *Arthritis Rheum.* 69, 194–202  
Shiboski CH, Shiboski SC, Seror R et al. (2017) International Sjögren's Syndrome Criteria Working Group, authors. 2016 American College of Rheumatology/European League Against Rheumatism classification criteria for primary Sjögren's syndrome: a consensus and data-driven methodology involving three international patient cohorts. *Ann Rheum Dis.* 76, 9–16  
Smiyan SI, Shkilna MI, Regalyuk VV et al. (2018) Modern aspects of etiology, pathogenesis, clinical course and treatment of Lyme arthritis (review, own observations). *Ukr J Rheumatol.* 72, 40–45  
Alunno A, Leone MC, Giacomelli R et al. (2018) Lymphoma and lymphomagenesis in primary Sjögren's syndrome. *Front Med (Lausanne)* 5, 102  
Smiyan S, Galaychuk I, Zhulkevych I et al. (2019) Case report. Sjögren's syndrome and lymphadenopathy unraveling the diagnosis of Lyme disease. *Reumatologia* 2019; 57, 1: 59-62. DOI: <https://doi.org/10.5114/reum.2019.83242>  
<https://www.termedia.pl/Sjogren-s-syndrome-and-lymphadenopathy-unraveling-the-diagnosis-of-Lyme-disease.18.35945.1.1.html>  
Jutras BL, Lochhead RB, Kloos ZA et al. (2019) Borrelia burgdorferi peptidoglycan is a persistent antigen in patients with Lyme arthritis. *Proc Natl Acad Sci U S A.* pii: 201904170. doi: 10.1073/pnas.1904170116

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.12.12 Pneumologic**

### **Immunosystem**

Grunewald J, Eklund A, Olerup O (2004). Human leukocyte antigen class I alleles and the disease course in sarcoidosis patients. *American Journal of Respiratory and Critical Care Medicine.* 169 (6): 696–702.

[CiteSeerX 10.1.1.321.2788](#). doi:10.1164/rccm.200303-459OC. PMID 14656748.

Grunewald J (2010) Review: role of genetics in susceptibility and outcome of sarcoidosis. *Seminars in Respiratory and Critical Care Medicine.* 31 (4), 380–9. doi:10.1055/s-0030-1262206. PMID 20665388.

Gialafos E, Triposkiadis F, Kouranos V, Rapti A, Kosmas I, Manali E, Giamouzis G, Elezoglou A, Peros I, Anagnostopoulou O, Koulouris N, Gazouli M (2014) Relationship between tumor necrosis factor- $\alpha$  (TNFA) gene polymorphisms and cardiac sarcoidosis. *In Vivo.* 28 (6), 1125–9. PMID 25398810.

Rossides M, Grunewald J, Anders E et al. (2018) [Familial Aggregation and Heritability of Sarcoidosis: A Swedish Nested Case-Control Study](#). *European Respiratory Journal.* 52 (2) 1800385. doi:10.1183/13993003.00385-2018. ISSN 0903-1936. PMID 29946010.

### **Bacteria**

Almenoff PL, Johnson A, Lesser M, Mattman LH (1996) Growth of acid fast L forms from the blood of patients with sarcoidosis. *Thorax.* 51 (5), 530–3. doi:10.1136/thx.51.5.530. PMC 473601. PMID 8711683.

Jacob F (1989) Could Borrelia burgdorferi be a causal agent of sarcoidosis? *Med Hypotheses* 30, 241–243.

Ishihara M, Ohno S, Ono H, et al. (1998) Seroprevalence of anti-Borrelia antibodies among patients with confirmed sarcoidosis in a region of Japan where Lyme borreliosis is endemic. *Graefes Arch Clin Exp Ophthalmol* 236, 280–284.

Klint H, Siboni AH (2000) Borreliosis associated with Lofgren's syndrome. *Ugeskr Laeger* 162, 4154–4155

Izbicki G, Chavko R et al. (2007) World Trade Center "sarcoid-like" granulomatous pulmonary disease in New York City Fire Department rescue workers. In: *Chest.* 131(5), 1414–1423, doi:10.1378/chest.06-2114. PMID 17400664.

Almenoff PL, Johnson A, Lesser M, Mattman LH (1996) Growth of acid fast L forms from the blood of patients with sarcoidosis. *Thorax.* 51 (5), 530–3. doi:10.1136/thx.51.5.530. PMC 473601. PMID 8711683.

Gupta D, Agarwal A et al. (2007) Molecular evidence for the role of mycobacteria in sarcoidosis: a meta-analysis. In: *The European respiratory journal.* 30(3), 508–516, doi:10.1183/09031936.00002607. PMID 17537780.

Iannuzzi MC, Rybicki BA, Teirstein AS (2007) Sarcoidosis. *N Engl J Med.* 357(21), 2153-65. Review. No abstract available. PMID:18032765

Derler AM, Eisendle K, Baltaci M, et al. (2009) High prevalence of 'Borrelia - like' organisms in skin biopsies of sarcoidosis patients from Western Austria. *J Cutan Pathol* 36, 1262– 1268.

Saidha S, Sotirchos ES, Eckstein C (2012) Etiology of sarcoidosis: does infection play a role?. *The Yale Journal of Biology and Medicine.* 85 (1), 133–41. PMC 3313528. PMID 22461752.

Müller-Quernheim J, Prasse A, Zissel G (2012) Pathogenesis of sarcoidosis. *Presse Médicale.* 41 (6 Pt 2), e275–87. doi:10.1016/j.lpm.2012.03.018. PMID 22595775



Saidha S, Sotirchos ES, Eckstein C (2012) Etiology of sarcoidosis: does infection play a role? *The Yale Journal of Biology and Medicine*. 85 (1), 133–41. PMC 3313528. PMID 22461752.  
Müller-Quernheim J, Prasse A, Zissel G (2012) Pathogenesis of sarcoidosis. *Presse Médicale*. 41 (6 Pt 2), e275–87. doi:10.1016/j.lpm.2012.03.018. PMID 22595775.  
van Dee L, Stehouwer M, van Bemmel T (2018) Systemic Sarcoidosis Associated with Exposure to *Borrelia burgdorferi* in a 21-Year-Old Man  
*European Journal of Case Reports in Internal Medicine*. 5(10), 000942. eCollection 2018.  
[https://doi.org/10.12890/2018\\_000942](https://doi.org/10.12890/2018_000942) <https://www.ejcrim.com/index.php/EJCRIM/article/view/942/1538>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.12.13 Digestive trakt**

### **Dental and oral care**

#### **Bacteria**

Don Chalmers Lyons (1936) The Incidence and Significance of the Presence of *Borrelia vincenti* and Other Spirochaetaceae on Beverage Glasses. *J. Bacteriol.* 31(5), 523

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC543740/>

Pino Rivero V, González Palomino A, Blasco Huelva A (2006) Plaut-Vincent's acute necrotizing ulcerative fusospirillum tonsillitis associated to infectious mononucleosis. [Case Reports]. *An Otorrinolaringol Ibero Am* 33(3), 219-24 <http://www.ncbi.nlm.nih.gov/pubmed/16881548>

Biswas D, Nick StaVord N (2010) *Borrelia tonsillitis*: common symptoms but uncommon organism. *Eur Arch Otorhinolaryngol* 267, 989–990 DOI 10.1007/s00405-010-1229-8

<http://www.ncbi.nlm.nih.gov/pubmed/20237790>

Zhang B, Khalaf H, Sirsjö A, Bengtsson T (2015) Gingipains from the periodontal pathogen *Porphyromonas gingivalis* play a significant role in regulation of Angiopoietin 1 and Angiopoietin 2 in human aortic smooth muscle cells. *Infect. Immun.* doi:10.1128/IAI.00498-15 <http://iai.asm.org/content/early/2015/08/11/IAI.00498-15.full.pdf>

Konig MF, Abusleme L, Reinholdt J et al. (2016) *Aggregatibacter actinomycetemcomitans*-induced hypercitrullination links periodontal infection to autoimmunity in rheumatoid arthritis. *Science Translational Medicine*, 8 (369), 369ra176 DOI: [10.1126/scitranslmed.aaj1921](https://doi.org/10.1126/scitranslmed.aaj1921)

Jinghua Sun J, Min Zhou M, Salazar ChrR et al. (2017) Chronic Periodontal Disease, Periodontal Pathogen Colonization, and Increased Risk of Precancerous Gastric Lesions. *Journal of Periodontology* 88(11), 1124-1134 <https://doi.org/10.1902/jop.2017.160829>

<http://www.joponline.org/doi/10.1902/jop.2017.160829>

Carter ChJ, France J, StJ, Singhrao SK (2017) The *Porphyromonas gingivalis*/host interactome shows enrichment in GWASdb genes related to Alzheimer's disease, diabetes and cardiovascular diseases. *Front. Aging Neurosci.* | doi: 10.3389/fnagi.2017.00408

#### **Toxins**

Kulacz R, Levy TE (2002) *The Roots of Disease: Connecting Dentistry and Medicine*.

<http://www.amazon.com/The-Roots-Disease-Connecting-Dentistry/dp/1401048943>

"This is a book that explains why root canals are not a good idea. It is impossible to sterilize an infected tooth due to the honey comb nature of the tooth's structure. Mercury amalgams and root canals are source of many of our patients' ills".

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.12.14 Leaky gut, Colitis, Hepatitis, Cholangitis**

### **Immunosystem**

Schuerer-Maly CC, Eckman L, Kagnoff MF, Falco MT, Maly FE. (1995) Colonic epithelial cell lines as a source of interleukin-8: Stimulation by inflammatory cytokines and bacterial lipopolysaccharide. *Immunology* 81, 85-91.

Stoll ML et al. (2014) [Altered microbiota associated with abnormal humoral immune responses to commensal](#)

[organisms in enthesitis-related arthritis](#). Arth Res Ther 16, 486.

Costello ME et al. (2014) [Intestinal dysbiosis in ankylosing spondylitis](#). Arth Rheum DOI: 10.1002/art.38967.

Salvioli B, Pellegatta G, Malacarne M et al. (2015) Autonomic nervous system dysregulation in irritable bowel syndrome. Neurogastroenterology & Motility. DOI: 10.1111/nmo.12512

<http://onlinelibrary.wiley.com/doi/10.1111/nmo.12512/abstract>

Perlmutter D (2015) Belly and the Brain <https://www.youtube.com/watch?v=ClcENEEqn3A>

### Viruses

Goellner MH, Agger WA, Burgess JH, Duray PH. (1988) Hepatitis due to recurrent Lyme disease. Ann Intern Med 108, 707-708.

Ruane PJ, Nakata MM, Reinhardt JF, George WL (1989) Spirochete-like organisms in the human gastrointestinal tract. Rev Infect Dis 11, 184-186.

Dauzan YR, Merlio JP, Grelier P, Ip Kan Fong H, Dachary D, Gousso JF, de Mascarel A. (1990) Colorectal spirochetosis. Ann Pathol 10, 258-261

Chiodini RJ, Hermon-Taylor J (1993) The thermal resistance of Mycobacterium paratuberculosis in raw milk under conditions simulating pasteurisation. Journal of Veterinary Diagnostic Investigation 5, 629-631

Prantera C, Kohn A et al. (1994) Antimycobacterial therapy in Crohn's disease: results of a controlled, double-blind trial with a multiple antibiotic regimen. Am J Gastroenterol 89(4), 513-8

<http://www.ncbi.nlm.nih.gov/pubmed/8147352>

„This study suggests that the treatment regimen with rifampicin, ethambutol, clofazimine, and dapsone is effective in relief of symptoms and maintenance of remission in some Crohn's disease patients“.

Fried MD, Duray P, Pietrucha D (1996) Gastrointestinal pathology in children with Lyme disease. Journal of Spirochetal and Tick-borne Diseases 3, 101-104.

Fried MD, Abel M, Pietrucha D, Yen-Hong K, Ball A (1999) The spectrum of gastrointestinal manifestations in children and adolescents with Lyme disease. J Spirochetal and Tick-Borne Diseases, 6, 89-93

Fried, MD, Pietrucha D et al. (2002) Borrelia burgdorferi persists in the Gastrointestinal tract of Children and Adolescents with Lyme Disease. Journal of Spirochetal and Tick- Borne Diseases. Vol. 9, No. 1, 11-15.

Fried MD, Schairer J, Madigan G, Ball A. (2002) Bartonella henselae is associated with heartburn, abdominal pain, skin rash, mesenteric adenitis, gastritis and duodenitis. J Pediatr. Gastroenterol. Nutr. 35, 3 Abstract 158

Fried MD, Adelson ME, Mordechai E (2004) Simultaneous Gastrointestinal Infections in Children and Adolescents, Practical Gastroenterology, 87-80.

Sherr VT (2006) Bell's Palsy of the Gut and other Manifestations of Lyme and Associated Diseases. Practical Gastroenterology. <http://thehumansideoflyme.net/viewarticle.php?aid=62>

Borody TJ et al. (2007) Anti-mycobacterial therapy in Crohn's disease heals mucosa with longitudinal scars. Digestive and Liver Disease 39, 438-444

«METHODS: Patients received rifabutin (up to 600 mg/day), clofazimine (up to 100 mg/day) and clarithromycin (up to 1 g/day) - anti-Mycobacterium avium ss paratuberculosis therapy - for 6 months to 9 years. Ramp-up dosing was used. Colonoscopies and histological analyses monitored progress.»

Chamberlin W et al. (2007) Successful treatment of a Crohn's Disease patient infected with bacteremic Mycobacterium paratuberculosis. American Journal of Gastroenterology 102, 689-691

«The patient started treatment consisting of split doses of clarithromycin 1,000 mg daily, rifabutin 300–450 mg daily, and levofloxacin 500 mg daily».

Clancy R et al. (2007) Molecular evidence for Mycobacterium avium subspecies paratuberculosis (MAP) in Crohn's disease correlates with enhanced TNF- $\alpha$  secretion. Digestive and Liver Disease 39, 445-451

Selby W et al. (2007) Two-year combination antibiotic therapy with clarithromycin, rifabutin, and clofazimine for Crohn's disease. Gastroenterology 132, 2313-2319 <http://www.ncbi.nlm.nih.gov/pubmed/17570206>

« Using combination antibiotic therapy with clarithromycin, rifabutin, and clofazimine for up to 2 years, we did not find evidence of a sustained benefit. This finding does not support a significant role for Mycobacterium avium subspecies paratuberculosis in the pathogenesis of Crohn's disease in the majority of patients. Short-term improvement was seen when this combination was added to corticosteroids, most likely because of nonspecific antibacterial effects ».

Stein M. (2009) Morbus Crohn durch Mykobakterien Ein Verdacht wird zur Gewissheit. EU.L.E.N-SPIEGEL • Nr. 2 / 2009 • © EU.L.E. e.V. • [www.das-eule.de](http://www.das-eule.de)

[http://www.euleev.de/images/Beitraege/Morbus\\_Crohn.pdf](http://www.euleev.de/images/Beitraege/Morbus_Crohn.pdf)

Schweig S (2014) The Lyme and Gut Connection The Role of Diet and Gastrointestinal Health in Treating Lyme Disease [https://www.youtube.com/watch?v=qBTQBnG\\_Uno](https://www.youtube.com/watch?v=qBTQBnG_Uno)

### Bacteria

Zaidi SA, Singer C. (2002) Gastrointestinal and hepatic manifestations of tickborne diseases in the United States. Clin Infect Dis. 34(9), 1206-12. Epub 2002 Apr 2. Review.

<https://pdfs.semanticscholar.org/72fe/4ff86135651934b22fd5c8d2a1958cb15ece.pdf>

« Abdominal complaints are more common among patients with RMSF and may occasionally lead to an erroneous diagnosis of an acute abdomen and result in unnecessary surgery. Diarrhea is most frequently seen in patients with ehrlichiosis, RMSF, tularemia, and TBRF. Almost all of these infections involve the liver with varying degrees of severity

and should be included in the differential diagnosis of acute hepatitis in areas of endemicity. The exceptions are Colorado tick fever and babesiosis, which do not commonly lead to hepatocellular injury. Q fever, in particular, and Lyme disease, ehrlichiosis, and tularemia, to a lesser extent, should be kept in mind when considering a diagnosis of granulomatous hepatitis in patients with an appropriate history of travel or exposure. Cholestasis and jaundice are most pronounced in patients with ehrlichiosis. They are uncommon in patients with Lyme disease, tularemia, Colorado tick fever, and TBRF, and they are seen variably in the rest. Finally, Lyme disease, ehrlichiosis, and babesiosis are transmitted by a common tick vector (*Ixodes* species ticks). Coinfection with any combination of the 3 pathogens is possible. Diagnosis of one of these diseases should prompt an evaluation for the presence of coexistent tickborne infections.“

Dejea ChM, Fathi P, Craig JM et al. (2018) Patients with familial adenomatous polyposis harbor colonic biofilms containing tumorigenic bacteria. *Science* 359(6375), 592-597 DOI: 10.1126/science.aah3648 <http://science.sciencemag.org/content/359/6375/592>

« We identified patchy bacterial biofilms composed predominately of *Escherichia coli* and *Bacteroides fragilis*. ... These data suggest an unexpected link between early neoplasia of the colon and tumorigenic bacteria.“

### **Mycoses, Fungi**

Munoz P, Bouza E, Cuenca-Estrella M et al (1998) Species identification and virulence attributes of *Saccharomyces boulardii* (nom. inval.). *J Clin Microbiol* 36, 2613 - 7. [Abstract / FREE Full Text](#)

McFarland LV (2002) Seven cases of fungemia with *Saccharomyces boulardii* in critically ill patients. *Intensive Care Med* 28, 797 - 801. [CrossRefMedlineWeb of Science](#)

Cordell B, McCathy J (2013) A Case Study of Gut Fermentation Syndrome (Auto-Brewery) with *Saccharomyces cerevisiae* as the Causative Organism. *International Journal of Clinical Medicine*, 4, 309-312 doi:10.4236/ijcm.2013.47054 Published Online July 2013 (<http://www.scirp.org/journal/ijcm>) <http://www.scirp.org/journal/PaperInformation.aspx?PaperID=33912>

### **Toxins**

[Campbell AK](#), [Matthews SB](#), [Vassel N](#), [Cox CD](#), [Naseem R](#), [Chaichi J](#), [Holland IB](#), [Green J](#), [Wann KT](#) (2010) Bacterial metabolic 'toxins': a new mechanism for lactose and food intolerance, and irritable bowel syndrome. *Toxicology*. 278(3), 268-76. doi:10.1016/j.tox.2010.09.001. Epub 2010 Sep 18. <http://www.ncbi.nlm.nih.gov/pubmed/20851732>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **Nephrologic, hämatologic, angiologic aund sexual diagnoses**

### **2.12.15 Nephrologic**

#### **Bacteria**

Fernandes PB, Panos C (1977) Wall-less microbial isolate from a human renal biopsy. *J. Clin. Microbiol.* 5, 106-107

Bosler EM, Schulze TL (1986) The prevalence and significance of *Borrelia burgdorferi* in the urine of feral reservoir hosts. *Zentralbl Bakteriell Mikrobiol Hyg [A]*. 263, 40-44

Schwan TG, Burgdorfer W, Schrupf ME, Karstens RH (1988) The urinary bladder, a consistent source of *Borrelia burgdorferi* in experimentally infected white-footed mice (*Peromyscus leucopus*). *J Clin Microbiol* 26, 893-895

Schwan TG, MacDonald AB (1989) INTERSTITIAL CYSTITIS AND BORRELIA BURGdorFERI [LETTER] *Ann Intern Med* 111(6), 537 <http://www.ncbi.nlm.nih.gov/pubmed/2774376> <http://annals.org/article.aspx?articleid=703382>

[Burgess EC](#) (1988) *Borrelia burgdorferi* infection in Wisconsin horses and cows. *Ann N Y Acad Sci.* 539, 235-43 [Horse and cow, urine PCR positive]. <http://www.ncbi.nlm.nih.gov/pubmed/3190095>

Callister SM, Agger WA, Schell RF, Brand KM (1989) Efficacy of the urinary bladder for isolation of *Borrelia burgdorferi* from naturally infected, wild *Peromyscus leucopus*. *J Clin Microbiol* 27,773-774

Chancellor MB, Dato VM, Yang JY (1990) Lyme disease presenting as urinary retention. *J Urol* 143, 1223-1224

Chancellor MB, McGinnis DE, Shenot PJ, Hirsch ICH, Kiilholma PJ (1992) LYME CYSTITIS AND NEUROGENIC BLADDER DYSFUNCTION [LETTER] *Lancet* 339(8803), 1237-8 <http://www.thelancet.com/journals/lancet/article/PII0140-6736%2892%2991184-A/fulltext>

Chancellor MB, McGinnis DE, Shenot PJ, Kiilholma P, Hirsch ICH (1993) Urinary dysfunction in Lyme disease. *J Urol.* 149(1), 26-30. <http://www.lymeneteurope.org/forum/viewtopic.php?f=5&t=4502>

Domingue GJ, GhoniemGM, Bost KL et al. (1995) Dormant microbes in intestinal cystitis. *J. Urol.* 153, 1321-1326

Bayer ME, Zhang L, Bayer MH (1996) *Borrelia burgdorferi* DNA in the urine of treated patients with chronic Lyme disease symptoms. A PCR study of 97 cases. *Infection* 24 No.5. 347–353.  
<http://www.ncbi.nlm.nih.gov/pubmed/8923044>

Dambach DM, Smith CA, Lewis RM, Van Winkle TJ. (1997) Morphologic, immunohistochemical, and ultrastructural characterization of a distinctive renal lesion in dogs putatively associated with *Borrelia burgdorferi* infection: 49 cases (1987-1992). *Vet Pathol.* 34(2), 85-96.  
<http://www.ncbi.nlm.nih.gov/pubmed/9066075>

Bauerfeind R, Kreis U, Weiss R, Wieler LH, Baljer G (1998) DETECTION OF BORRELIA BURGDORFERI IN URINE SPECIMENS FROM DOGS BY A NESTED POLYMERASE CHAIN REACTION. *Zentralbl Bakteriol* 287(4), 347-61 <http://www.ncbi.nlm.nih.gov/pubmed/9638865>

Haarala M, Kiiholma P, Nurmi M, Uksila J, Alanen A (2000) The role of *Borrelia burgdorferi* in interstitial cystitis. *Eur Urol.* 37(4), 395-9. <http://www.ncbi.nlm.nih.gov/pubmed/10765068>  
<https://www.researchgate.net/publication/12551591> The role of *Borrelia burgdorferi* in interstitial cystitis

Kirmizis D, Efstratiadis G, Economidou D, Diza-Mataftsi E, Leontsini M, Memmos D. (2004) MPGN secondary to Lyme disease. *Am J Kidney Dis.* 43(3), 544-51. <http://www.ncbi.nlm.nih.gov/pubmed/14981613>  
 « We report a patient with acute postinfection membranoproliferative glomerulonephritis after the clinical multisystem manifestation of Lyme disease, which was confirmed serologically. Although the patient was dialysis dependent for a protracted period of 5 months, the final outcome was excellent».

Chitale S, Burgess N, Barker THW, Roberts PF (2005) Pseudospirochaetosis of the urinary bladder. *J Clin Pathol* 58, 437–438. doi:10.1136/jcp.2004.020529 <http://www.ncbi.nlm.nih.gov/pubmed/15790716>  
 « Special stains showed that the organisms were Gram and Giemsa positive, weakly argyrophilic, and Ziehl-Nielsen negative. Immunostains were negative for *Helicobacter pylori* and electron microscopy revealed curious curved bodies, which were difficult to classify. Therefore, this condition was described as pseudospirochaetosis of the urinary bladder.»

Mc Causland FR, Niedermaier S, Bijol V, Rennke HG, Choi ME, Forman JP. (2011) Lyme disease-associated glomerulonephritis. *Nephrol Dial Transplant.* 26(9), 3054-6. doi: 10.1093/ndt/gfr335. Epub 2011 Jul 12.  
<http://www.ncbi.nlm.nih.gov/pubmed/21750163>

Kim MH, Kim WC, Park DS (2012) Neurogenic bladder in lyme disease. *Int Neurourol J.* 16(4), 201-4. doi: 10.5213/inj.2012.16.4.201. Epub 2012 Dec 31. <http://www.ncbi.nlm.nih.gov/pubmed/23346488>

Rolla D, Conti N, Ansaldo F, Panaro L, Lusenti T (2013) Post-infectious glomerulonephritis presenting as acute renal failure in a patient with Lyme disease. *J Renal Inj Prev.* 3(1), 17-20. doi: 10.12861/jrip.2014.07. eCollection 2014. <http://www.ncbi.nlm.nih.gov/pubmed/25340158>  
 « *Borrelia burgdorferi* is a possible cause of post-infectious GN in humans as it is in dogs. Difficulties in identifying *Borrelia burgdorferi* may also be one of the reasons for the paucity of reports on the association of this infection with glomerulonephritis in humans. Currently, various types of histological renal lesions have been reported ».

Horney BS, Stojanovic V (2013) Protein-losing nephropathy associated with *Borrelia burgdorferi* seropositivity in a soft-coated wheaten terrier: Response to therapy. *Can Vet J.* 54(4), 392–396.  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3595947/>

Littman MP. (2013) Lyme nephritis. *J Vet Emerg Crit Care (San Antonio).* 23(2), 163-73. doi:10.1111/vec.12026. Epub 2013 Mar 5. <http://www.ncbi.nlm.nih.gov/pubmed/23461642>

[Back](#)

Windows Alt + left arrow  
 Apple to start Fn + left arrow

## 2.12.16 Hämatologic

### Immunosystem

Bluth MH, Robin J, Ruditsky M, Norowitz KB, Chice S, Pytlak E, Nowakowski M, Durkin HG, Smith-Norowitz TA. (2007) IgE anti-*Borrelia burgdorferi* components (p18, p31, p34, p41, p45, p60) and increased blood CD8+CD60+ T cells in children with Lyme disease. *Scand J Immunol.* 65(4), 376-82.  
<http://www.ncbi.nlm.nih.gov/pubmed/17386029>

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3083.2007.01904.x/full>

Commins SP, Satinover SM, Hosen J, Mozena J, Borish L, Lewis BD, et al. (2009) Delayed anaphylaxis, angioedema, or urticaria after consumption of red meat in patients with IgE antibodies specific for galactose- $\alpha$ -1,3-galactose. *J Allergy Clin Immunol.* 123, 426–33. [PMC free article] [PubMed]

Commins SP, James HR, Kelly EA (2011) The relevance of tick bites to the production of IgE antibodies to the mammalian oligosaccharide galactose- $\alpha$ -1,3-galactose. *J Allergy Clin Immunol.* 127(5), 1286–1293.e6. . doi: 10.1016/j.jaci.2011.02.019 PMID: PMC3085643 NIHMSID NIHMS273885

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3085643/>

Van Nunen SA, O'Connor KS, Clarke LR, Boyle RX, Fernando SL. (2009) An association between tick bite reactions and red meat allergy in humans. *Med J Australia.* 190, 510–1. [PubMed]



Erwin EA, Hosen J, Pollart SM, Reid MJ, Platts-Mills TA. (2009) High-titer IgE antibody specific for pollen allergens in northern California associated with both wheezing and total serum IgE. *J Allergy Clin Immunol.* 123, 706–8. [[PMC free article](#)] [[PubMed](#)]

Burke G, Wikel SK, Spielman A, Telford SR, McKay K, Krause PJ, et al. (2010) Hypersensitivity to ticks and Lyme disease risk. *Emerg Infect Dis.* 2005 Jan; serial on the Internet. accessed December 2010. [[PMC free article](#)] [[PubMed](#)]

Reiter A, Goede J, Metzgeroth G, Sperr WR, Valent P (2011) Eosinophilie - assoziierte Myeloproliferative Erkrankungen (MPN-Eo)

<http://www.dgho-onkopedia.de/de/onkopedia/leitlinien/eosinophilie-assoziierte-myeloproliferative>

Wolver SE, Sun DR, Commins SP, Schwartz LB (2012) [A Peculiar Cause of Anaphylaxis: No More steak? The Journey to Discovery of a Newly Recognized Allergy to Galactose-alpha-1,3-galactose Found in Mammalian Meat.](#) *Journal of General Internal Medicine* DOI: 10.1007/s11606-012-2144-z

<http://link.springer.com/article/10.1007%2Fs11606-012-2144-z>

Buda P, Zawadka K, Wadowska-Kłopotek W et al. (2015) Cerebrospinal fluid eosinophilia in a child with neuroborreliosis. *Wiad Lek.* 68(1), 92-4. <http://www.ncbi.nlm.nih.gov/pubmed/26094340>

#### **Viruses**

Wedi B, Rapp U, Wioczonek D, Kapp A (2009) Urticaria and infections. *Allergy Asthma Clin Immunol.* 5(1), 10 doi: [10.1186/1710-1492-5-10](https://doi.org/10.1186/1710-1492-5-10)

#### **Bacteria**

[Benach JL](#), [Gruber BL](#), [Coleman JL](#), [Habicht GS](#), [Golightly MG](#). (1986) An IgE response to spirochete antigen in patients with Lyme disease. *Zentralbl Bakteriol Mikrobiol Hyg A.* 263(1-2), 127-32.

<http://www.ncbi.nlm.nih.gov/pubmed/2437736>

Vichova B, Miterpakova M, Iglodyova A. (2014) Molecular detection of co-infections with *Anaplasma phagocytophilum* and/or *Babesia canis canis* in *Dirofilaria*-positive dogs from Slovakia. *Vet Parasitol.* pii: S0304-4017(14)00064-8 <http://www.ncbi.nlm.nih.gov/pubmed/24630708>

[Minciullo PL](#), [Cascio A](#), [Barberi G](#), [Gangemi S](#). (2014) Urticaria and bacterial infections. *Allergy Asthma Proc.* <http://www.ncbi.nlm.nih.gov/pubmed/24857191>

„Many bacterial infections have been associated with urticaria manifestation, such as *Helicobacter pylori*, *Streptococcus*, *Staphylococcus*, *Mycoplasma pneumonia*, *Salmonella*, *Brucella*, *Mycobacterium leprae*, *Borrelia*, *Chlamydia pneumonia*, and *Yersinia enterocolitica*. In some cases the skin manifestations, described as urticaria, could be caused by the presence of the microorganism in the skin, or for the action of their toxins, or to the complement activation mediated by circulating immune complexes. Although only a weak association with urticaria of unclear pathogenesis exists, clinicians should consider these bacterial agents in the workup of the patients with urticaria. The eradication of the infection could, in fact, lead to the resolution of urticaria.“

#### **Nematodes, Filaria**

[González-Miguel J](#), [Rosario L](#), [Rota-Nodari E](#), [Morchón R](#), [Simón F](#). (2010) Identification of immunoreactive proteins of *Dirofilaria immitis* and *D. repens* recognized by sera from patients with pulmonary and subcutaneous dirofilariosis. *Parasitol Int.* 59(2), 248-56.

doi: 10.1016/j.parint.2010.02.010. <http://www.ncbi.nlm.nih.gov/pubmed/20197111>

Czajka C, Becker N, Joest H, et al. (2014) Stable transmission of *Dirofilaria repens* nematodes, northern Germany. *Emerg Infect Dis.* 20(2), 328-31 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3901495/>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.12.17 Angiologic, cardiologic**

### **Immunosystem**

Wenzel K, Ernst M, Rohde K, Baumann G, Speer A (1996) DNA polymorphisms in adhesion molecule genes - a new risk factor for early atherosclerosis. *Human Genetics* 97, 15-20

[Nichols L](#), [Lagana S](#), [Parwani A](#) (2008) Coronary artery aneurysm: a review and hypothesis regarding etiology. *Arch Pathol Lab Med.* 132(5), 823-8. doi: 10.1043/1543-2165(2008)132[823:CAAARA]2.0.CO;2. <https://www.ncbi.nlm.nih.gov/pubmed/18466032>

„Increased proteolysis of extracellular matrix proteins is probably one mechanism of coronary artery aneurysm formation, either due to overactive matrix metalloproteinases or underactive inhibition of these proteinases, and an excess of transforming growth factor beta may be another mechanism in the pathogenesis.“

Choi AJS, Ryter SW (2011) Review Article Autophagy in Inflammatory Diseases. *International Journal of Cell Biology* Volume 2011, Article ID 732798, 11 pages doi:10.1155/2011/732798

<http://www.hindawi.com/journals/ijcb/2011/732798/>

Moore KJ, Tabas I (2011) Macrophages in the pathogenesis of atherosclerosis. *Cell* 145, 341–355. [Google Scholar](#), [Crossref](#), [Medline](#), [ISI](#)

Libby P (2012) Inflammation in Atherosclerosis. *Arterioscler Thromb Vasc Biol* 32 2045–2051. [Google Scholar](#), [Crossref](#), [Medline](#), [ISI](#)

Towfique Raj, Manik Kuchroo, Joseph M. Replogle, Soumya Raychaudhuri, Barbara E. Stranger, Philip L. De Jager. (2013) Common Risk Alleles for Inflammatory Diseases Are Targets of Recent Positive Selection. *The American Journal of Human Genetics*, DOI: [10.1016/j.ajhg.2013.03.001](https://doi.org/10.1016/j.ajhg.2013.03.001)

Ramesh G, Maclean AG, Philipp MT. (2013) Cytokines and Chemokines at the Crossroads of Neuroinflammation, Neurodegeneration, and Neuropathic Pain. *Mediators Inflamm*. 480739. Epub. <http://www.ncbi.nlm.nih.gov/pubmed/23997430>

Parthasarathy G, Philipp MT. (2013) Non-viable *Borrelia burgdorferi* induce inflammatory mediators and apoptosis in human oligodendrocytes. *Neurosci Lett*. 556:200-3. doi: 10.1016/j.neulet.2013.10.032. Epub 2013 Oct 22. <http://www.ncbi.nlm.nih.gov/pubmed/24157855>

<http://www.bioportfolio.com/resources/pmarticle/712797/Non-viable-Borrelia-burgdorferi-induce-inflammatory-mediators-and-apoptosis-in-human-oligodendrocytes.html>

Soloski MJ, Crowder LA, Lahey LJ et al. (2014) Serum inflammatory mediators as markers of human Lyme disease activity. *PLoS One*. 9(4), e93243. doi: 10.1371/journal.pone.0093243. eCollection 2014. <http://www.ncbi.nlm.nih.gov/pubmed/24740099>

Back M, Hansson GK (2015) Anti-inflammatory therapies for atherosclerosis. *Nat Rev Cardiol* 12, 199–211. [Google Scholar](#), [Crossref](#), [Medline](#)

Aiello AE, Jayabalasingham B, Simanek AM et al. (2017) The impact of pathogen burden on leukocyte telomere length in the Multi-Ethnic Study of Atherosclerosis. *Epidemiol Infect*. 145(14), 3076-3084. doi: 10.1017/S0950268817001881. Epub 2017 Sep 7.

<https://www.ncbi.nlm.nih.gov/pubmed/28879822>

Tuñón J, Bäck M, Badimón L (2018) ESC Working Group on Atherosclerosis and Vascular Biology: Interplay between hypercholesterolaemia and inflammation in atherosclerosis: Translating experimental targets into clinical practice; *European Journal of Preventive Cardiology*; DOI: [10.1177/2047487318773384](https://doi.org/10.1177/2047487318773384) [PDF](#)

## Viruses

Khang JH, Ho JD, Chen YH et al. (2009) Increased Risk of Stroke after a Herpes Zoster Attack: A Population-Based Follow-Up Study. *Stroke* 40 (11), 3443-8

## Bacteria

Huisman BD (1969) *Der Aortenbogensatz bei luischen Aneurysmen*. Inaugural-Dissertation der Medizinischen Fakultät der Universität zu Köln.

Uldry PA, Regli, F, et al, (1987) Cerebral angiopathy and recurrent strokes following *Borrelia burgdorferi* infection. *J. Neurol. Neurosurg. Psychiatry* 50 (12), 1703-1704.

Veenendaal-Hilbers, JA, Perquin, WV, et al. (1988) Basal meningovascularitis and occlusion of the basilar artery in two cases of *Borrelia burgdorferi* infection. *Neurologists* 38 (8), 1317-1319.

Meier C, Grehl H, (1988) Vasculitic neuropathy in the Garin-Bujadoux-Bannwarth syndrome. A contribution to the understanding of the pathology and pathogenesis of the neurological complications in Lyme borreliosis. *Dtsch. Med. Wochenschr.* 113 (4), 135-138.

May EF, Jabbari B, (1990). Stroke in neuroborreliosis. *Stroke* 21 (8), 1232-1235.

Meurers B, Kohlhepp W, Gold R, Rohrbach E, Mertens HG (1990) Histopathological findings in the central and peripheral nervous systems in neuroborreliosis. A report of three cases. *J Neurol* 237, 113–116

Brogan GX Homan CS Viccellio P (1990) THE ENLARGING CLINICAL SPECTRUM OF LYME DISEASE: LYME CEREBRAL VASCULITIS, A NEW DISEASE ENTITY. [SEE COMMENTS]

*Ann Emerg Med* 19(5), 572-6 <http://www.ncbi.nlm.nih.gov/pubmed/2331105>

Hammers-Berggren S, Grondahl A, Karlsson M, von Arbin M, Carlsson A, Stiernstedt G (1993) Screening for neuroborreliosis in patients with stroke. *Stroke*. 24(9), 1393-6 <http://www.ncbi.nlm.nih.gov/pubmed/8362437>

Reik L Jr (1993) Stroke due to Lyme disease. *Neurology* 43(12), 2705-7

<http://www.ncbi.nlm.nih.gov/pubmed/8255484>

Delpla PA, Delisle MB, Arne-Bes MC, Archambaud M, Geraud G, Bes A (1993) MULTIPLE MONONEURITIS AND CEREBRAL MENINGO-ARTERITIS. WEGENER DISEASE OR LYME DISEASE? *Rev Neurol (Paris)* 149(6-7), 411-5 <http://www.ncbi.nlm.nih.gov/pubmed/8303161>

Defer G, Levy R, Brugieres P, Postic D, Degos JD (1993) LYME DISEASE PRESENTING AS A STROKE IN THE VERTEBROBASILAR TERRITORY: MRI. *Neuroradiology* 35(7), 529-31

<http://www.ncbi.nlm.nih.gov/pubmed/8232882>

Henriksen TB (1997) [LYME NEURO-BORRELIOSIS IN A 66-YEAR OLD WOMEN. DIFFERENTIAL DIAGNOSIS OF CEREBRAL METASTASES AND CEREBRAL INFARCTION] *Ugeskr Laeger* 159(21), 3175-7 <http://www.ncbi.nlm.nih.gov/pubmed/9199007>

Oksi J, Kalimo H, Marttila RJ et al. (1998) Intracranial aneurysms in three patients with disseminated Lyme borreliosis: cause or chance association? *J Neurol Neurosurg Psychiatry* 64, 636-642  
<http://jnnp.bmj.com/content/64/5/636.abstract>

Cook PJ, Honeybourne D, Lip GY et al. (1998) Chlamydia pneumonia antibody titers are significantly associated with acute stroke and transient cerebral ischemia: the West Birmingham Stroke Project. *Stroke; a journal of cerebral circulation*. 29 (45), 404-10

Wilke M, Eiffert H, et al. (2000) Primarily chronic and cerebrovascular course of Lyme neuroborreliosis: case reports and literature review. *Arch. Dis. Child*. 83 (1), 67-71.

Canver CC, Chanda J, DeBellis DM, Kelley JM (2000) Possible relationship between degenerative cardiac valvular pathology and Lyme disease. *Ann Thorac Surg*. 70(1), 283-5.  
<http://www.ncbi.nlm.nih.gov/pubmed/10921726>

Zhang Y, Lafontant G, Bonner FJ Jr. (2000) Lyme neuroborreliosis mimics stroke: a case report. *Arch Phys Med Rehabil* 81(4), 519-21 <http://www.ncbi.nlm.nih.gov/pubmed/10768546>

Prager M, Türel Z, Speidl WS et al (2002) Chlamydia pneumonia in carotid artery atherosclerosis: a comparison of its presence in atherosclerotic plaque, healthy vessels, and circulating leucocytes from the same individuals. *Stroke; a journal of cerebral circulation* 33(12), 2756-61

Heinrich A, Khaw A et al. (2003) Cerebral vasculitis as the only manifestation of *Borrelia burgdorferi* infection in a 17-year-old Patient with basal ganglia infarction. *Eur. Neurol*. 50 (2), 109-112.

Romi F, Krakenes J, Aarli JA, Tysnes OB (2004) Neuroborreliosis with vasculitis causing stroke-like manifestations. *Eur Neurol* 51, 49–50

Schmiedel J, Gahn G, et al. (2004) Cerebral vasculitis with multiple infarcts caused by Lyme disease. *Cerebrovasc. Dis*. 17 (1), 79-81

Leonardi S, Pavone P, Rotolo N et al. (2005) Stroke in two children with *Mycoplasma pneumoniae* infection. A causal relationship?. *The Pediatric infectious disease journal*. 24 (9), 843-5

Topakian R, Stieglbauer K, et al. (2007) Unexplained cerebral vasculitis and stroke: keep Lyme neuroborreliosis in mind. *Lancet Neurol*. 6 (9), 756-757.

Topakian R, Stieglbauer K, Nussbaumer K, Aichner FT (2008) Cerebral vasculitis and stroke in Lyme neuroborreliosis. Two case reports and review of current knowledge. *Cerebrovasc Dis* 26, 455–461

Rudenko N, Golovchenko M, Aleš Mokráček A et al. (2008) Detection of *Borrelia bissettii* in Cardiac Valve Tissue of a Patient with Endocarditis and Aortic Valve Stenosis in the Czech Republic. *J Clin Microbiol*. 46(10), 3540–3543. doi: [10.1128/JCM.01032-08](https://doi.org/10.1128/JCM.01032-08) PMID: PMC2566110  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2566110/>

Fallon BA et al. (2009) Inflammation and central nervous system Lyme disease, *Neurobiol. Dis.*, doi:10.1016/j.nbd.2009.11.016

Scheu JJ, Chiou HY, Kang JH et al (2009) Tuberculosis and the Risk of Ischemic Stroke: A 3-Year Follow-Up Study. *Stroke* 41 (2), 244-9

Adamaszek M, Heinrich A, Rang A, Langner S, Khaw AV (2010) Cerebral sinovenous thrombosis associated with Lyme neuroborreliosis. *J Neurol* 257, 481–483

Rai NK, Choudhary R, Bhatia R et al. (2011) Chlamydia pneumoniae seropositivity in adults with acute ischemic stroke: A case-control study. *Ann Indian Acad Neurol* 14, 93-7.  
<http://www.annalsofian.org/text.asp?2011/14/2/93/82792>

Hinterseher I, Gäbel G, Corvinus F, Lück C, Saeger HD, Bergert H, Tromp G, Kuivaniemi H. (2012) Presence of *Borrelia burgdorferi* sensu lato antibodies in the serum of patients with abdominal aortic aneurysms. *Eur J Clin Microbiol Infect Dis*. 31(5), 781-9. doi: 10.1007/s10096-011-1375-y. Epub 2011 Aug 13.  
<http://www.ncbi.nlm.nih.gov/pubmed/21842293>

“Our findings suggest a relationship between AAAs and *B. burgdorferi* sl. We hypothesize that the underlying mechanism for *B. burgdorferi* sl in AAA formation is similar to that by the spirochete *Treponema pallidum*; alternatively, AAAs could develop due to induced autoimmunity via molecular mimicry due to similarities between some of the *B. burgdorferi* sl proteins and aortic proteins.”

Back T, Grünig S, Winter Y, Bodechtel U, Guthke K, Khati D, von Kummer R. (2013) Neuroborreliosis-associated cerebral vasculitis: long-term outcome and health-related quality of life. *J Neurol*. 260(6), 1569-75.  
<http://www.ncbi.nlm.nih.gov/pubmed/23329377>

Renko J, Koskela KA, Lepp PW, et al. (2013) Bacterial DNA signatures in carotid atherosclerosis represent both commensals and pathogens of skin origin. *Eur J Dermatol*. 23(1), 53-8. doi: 10.1684/ejd.2012.1908.  
<http://www.ncbi.nlm.nih.gov/pubmed/23406581>

“The most prominent phylum, Actinobacteria, accounted for 74% of these relevant sequences. Furthermore, according to the Human Microbiome project database, interestingly, nearly all (94%) of the sequences were associated with the human skin microbiome.”

Ebady R, Niddam AF, Boczula AE et al. (2016) Biomechanics of *Borrelia burgdorferi* Vascular Interactions. *Cell Reports* DOI: <http://dx.doi.org/10.1016/j.celrep.2016.08.013>  
[http://www.cell.com/cell-reports/pdfExtended/S2211-1247\(16\)31059-2](http://www.cell.com/cell-reports/pdfExtended/S2211-1247(16)31059-2)

## **2.12.18 Cardiac stimulus conduction disease, cardiomyopathy**

### **Immunosystem**

Ryan MF, Thorn C (2013) Lyme carditis in an immunocompromised patient. *Case Rep Emerg Med.* 2013, 380734. doi: 10.1155/2013/380734. Epub 2013 Aug 1.

<http://www.ncbi.nlm.nih.gov/m/pubmed/24083037/?i=17&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

### **Viruses**

Sayers EG (1958) Diphtheritic myocarditis with permanent heart damage. *Ann Intern Med.* 48(1), 146-157.

Dung NM, Kneen R, Kiem N et al. (2002) Treatment of severe diphtheritic myocarditis by temporary insertion of a cardiac pacemaker. *Clin Infect Dis.* 35(11), 1425-1429.

Dennert R, Crijns HJ, Heymans S (2008) Acute viral myocarditis. *Eur Heart J.* 29(17), 2073-2082.

Kuchynka P, Palecek T, Grus T, Schramlova J et al. (2015) A high frequency of viral agents yet absence of *Borrelia burgdorferi* is seen within the myocardium of subjects with normal left ventricular systolic function: an electron microscopy study. *Folia Microbiol (Praha).* <http://www.ncbi.nlm.nih.gov/pubmed/26205424>

Agut H, Bonnafous P, Gautheret-Dejean A (2015) Laboratory and clinical aspects of human herpesvirus 6 infections. *Clin Microbiol Rev.* 28(2), 313-335.

Verdonschot J, Hazebroek M, Merken J et al. (2016) Relevance of cardiac parvovirus B19 in myocarditis and dilated cardiomyopathy: review of the literature. *Eur J Heart Fail.* 18(12), 1430-1441.

Tracy KE, Baumgarth N. (2017) *Borrelia burgdorferi* Manipulates Innate and Adaptive Immunity to Establish Persistence in Rodent Reservoir Hosts. *Front Immunol.* 8, 116. doi: 10.3389/fimmu.2017.00116. eCollection 2017 Feb 20. Review. PMID: 28265270 [PubMed - in process] Free PMC Article Similar articles

Stanford University. (2018) Coxsackie B virus and myocarditis. Accessed August 24, 2018.

Willis M (2018) FAQ of Types of Viruses and Bacteria that Cause Myocarditis. Myocarditis Foundation. <https://www.myocarditisfoundation.org/research-and-grants/faqs/causes-of-myocarditis/>.

### **Bacteria**

Steere AC, Batsford WP, Weinberg M, et al. (1980) Lyme carditis: cardiac abnormalities of lyme disease. *Ann Intern Med* 93, 8–16 CrossRef MEDLINE

Cornuau L, Bernard M, Daumas PL, Oblet B, Poirot G, Valois M (1984) Les manifestations cardiaques de la maladie de lyme: a propos de deux observations. *Ann Cardiol Angeiol* 33, 395–9 MEDLINE

Marcus LC, Steere AC, Duray PH, Anderson AE, Mahoney EB (1985) Fatal pancarditis in a patient with coexistent lyme disease and babesiosis. Demonstration of spirochetes in the myocardium. *Ann Intern Med* 103, 374–6 CrossRef MEDLINE

Allal J, Coisne D, Thomas P, et al. (1986) Manifestation cardiaques de la maladie de lyme. *Ann Med Interne* 137, 372–4 MEDLINE

Kapusta R, Fauchier JP, Cosnay P, Huguet R, Grezard O, Rouesnel P (1986) Troubles conductifs sinuauriculaires et auriculo-ventriculaires de la maladie de lyme: a propos de deux observations. *Arch Mal Coeur* 79, 1361–6 MEDLINE

Kirsch M, Ruben FL, Steere AC, Duray PH, Norden CW, Winkelstein A (1988) Fatal adult respiratory distress syndrome in a patient with lyme disease. *JAMA* 259, 2737–9 CrossRef CrossRef

van der Linde MR, Crijns HJ, Lie KI (1989) Transient complete AV-block in lyme disease: electrophysiologic observations. *Chest* 96, 219–21 CrossRef

van der Linde MR, Crijns HJ, de Koning J, et al. (1990) Range of atrioventricular conduction disturbances in lyme borreliosis: a report of four cases and review of other published reports. *Br Heart J.* 63, 162–8 CrossRef MEDLINE PubMed Central

van der Linde MR (1991) Lyme-carditis: clinical characteristics of 105 cases. *Scand J Infect Dis* 77, 81–4 MEDLINE

Mc Alister HF, Klementowicz C, Andrews JD, Fisher JD, Feld M, Furman S (1989) Lyme carditis: an important cause of reversible heart block in lyme disease. *Ann Intern Med* 110, 339–45 CrossRef

Stanek G, Klein J, Bittner R, Glogar D (1990) Isolation of *Borrelia burgdorferi* from the myocardium of a patient with long-standing cardiomyopathy. *N Engl J Med* 322, 249–52 CrossRef MEDLINE

Cary NR, Fox B, Wright DJM, Cutler SJ, Shapiro LM, Grace AA (1990) Fatal lyme carditis and endocardial heterotopia of the atrioventricular node. *Postgrad Med J* 66, 134–6 CrossRef

Cox J, Kraiden M (1991) Cardiovascular manifestations of lyme disease. *Am Heart J* 122, 1449–55 CrossRef

Woolf PK, Lorsung EM, Edwards KS (1991) Electrocardiographic findings in children with lyme disease.



Pediatr Emerg Care 7, 334–6 CrossRef

Vegsundvag J, Nordeide J, Reikvam A, Jenum P (1993) Late Cardiac Manifestation of Infection with *Borrelia burgdorferi* (Lyme Disease). *BMJ*, 307, 173. <http://dx.doi.org/10.1136/bmj.307.6897.173>

Lorincz I, Lakos A, Kovacs P (1989) Temporary pacing in complete heart block due to lyme disease: a case report. *PACE* 12, 1433–6 CrossRef

Pinto DS (2002) Cardiac manifestations of Lyme disease. *Med Clin North Am.* 86(2), 285-96. <http://www.ncbi.nlm.nih.gov/pubmed/11982302>

Haddad FA, Nadelman RB (2003) Lyme disease and the heart. *Front Biosci* 8, 769-782

Scheffold N, Bergler-Klein J, Sucker Chr, Cyran J (2003) Kardiovaskuläre Manifestationen der Lyme-Borreliose: Therapeutische Situation im chronischen Stadium problematisch. *Dtsch Arztebl* 100(14), A-912 / B-767 / C-717 <http://www.aerzteblatt.de/archiv/36332/Kardiovaskulaere-Manifestationsformen-der-Lyme-Borreliose-Therapeutische-Situation-im-chronischen-Stadium-problematisch>

Karaday B, Spieker E, Schwitter J (2004) Lyme carditis: restitutio ad integrum documented by cardiac MRI. *Cardiol Rev* 12, 185 CrossRef

Seslar SP, Berul CI, Burklow TR, Cecchin F, Alexander ME (2006) Transient prolonged corrected QT intervall in lyme disease. *J Pediatr* 148, 692–7 CrossRef MEDLINE

Lelovas P, Dontas I, Bassiakou E, Xanthos T (2008) Cardiac Implications of Lyme Disease, Diagnosis and Therapeutic Approach. *International Journal of Cardiology*, 129, 15-21. <http://dx.doi.org/10.1016/j.ijcard.2008.01.044>

Tavora F, Burke A, Li L, Franks TJ, Virmani R (2008) Postmortem confirmation of lyme carditis with polymerase chain reaction. *Cardiovasc Pathol* 17, 103–7 CrossRef MEDLINE

LeLeiko RM, Bower DJ, Larsen CP (2008) MRSA-associated bacterial myocarditis causing ruptured ventricle and tamponade. *Cardiology*. 111(3), 188-190.

Berger RE, McGillicuddy DC (2009) Lyme carditis. *Intern Emerg Med.* 4(5), 419-21. doi: 10.1007/s11739-009-0285-9. Epub 2009 Jul 21. <http://www.ncbi.nlm.nih.gov/m/pubmed/19626420/?i=93&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Earl TJ (2010) Cardiac manifestations of Lyme disease. *Med Health R I.* 93(11), 339-41. <http://rimed.org/medhealthri/2010-11/2010-11-339.pdf>

Wagner V, Zima E, Gellér L, Merkely B (2010) Acute atrioventricular block in chronic Lyme disease. *Orv Hetil.* 151(39), 1585-90. doi: 10.1556/OH.2010.28965. Article in Hungarian. <http://www.ncbi.nlm.nih.gov/pubmed/20840915>

Dolbec KW, Higgins GL, Saucier JR (2010) Lyme carditis with transient complete heart block. *West J Emerg Med.* 11(2), 211-2. PMID 20823977 [PubMed] PMCID PMC2908662 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2908662/>

Semmler D, Blank R, Rupprecht H (2010) Complete AV block in Lyme carditis: an important differential diagnosis. *Clin Res Cardiol.* 99(8), 519-26. doi: 10.1007/s00392-010-0152-8. <http://www.ncbi.nlm.nih.gov/pubmed/20464556>

Palecek T, Kuchynka P, Hulinska D, Schramlova J, Hrbackova H, Vitkova I, Simek S, Horak J, Louch WE, Linhart A (2010) Presence of *Borrelia burgdorferi* in endomyocardial biopsies in patients with new-onset unexplained dilated cardiomyopathy. *Med Microbiol Immunol.* 199(2), 139-43. doi: 10.1007/s00430-009-0141-6. Epub 2010 Jan 6. <http://www.ncbi.nlm.nih.gov/pubmed/20052487>

Bacino L, Gazzarata M, Siri G, Cordone S, Bellotti P (2011) Complete atrioventricular block as the first clinical manifestation of a tick bite (Lyme disease). *G Ital Cardiol (Rome).* 12(3), 214-6. <http://www.ncbi.nlm.nih.gov/pubmed/21560478>

Panic G, Stanulovic V, Popov T (2011) Atrio-ventricular block as the first presentation of disseminated Lyme disease. *Int J Cardiol.* 150(3), e104-6. doi: 10.1016/j.ijcard.2010.02.061. Epub 2010 Mar 11. <http://www.ncbi.nlm.nih.gov/m/pubmed/20226549/?i=84&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Hidri N, Barraud O, de Martino S, Garnier F, Paraf F, Martin C, Sekkal S, Laskar M, Jaulhac B, Ploy MC (2012) Lyme endocarditis. *Clin Microbiol Infect.* 18(12), E531-2. doi: 10.1111/1469-0691.12016. <http://www.ncbi.nlm.nih.gov/m/pubmed/23043635/?i=38&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Piccirillo BJ, Pride YB (2012) Reading between the Lyme: is *Borrelia burgdorferi* a cause of dilated cardiomyopathy? The debate continues. *Eur J Heart Fail.* 14(6), 567-8. doi: 10.1093/eurjhf/hfs047. [http://www.researchgate.net/publication/224006038\\_Reading\\_between\\_the\\_Lyme\\_is\\_Borrelia\\_burgdorferi\\_a\\_cause\\_of\\_dilated\\_cardiomyopathy\\_The\\_debate\\_continues](http://www.researchgate.net/publication/224006038_Reading_between_the_Lyme_is_Borrelia_burgdorferi_a_cause_of_dilated_cardiomyopathy_The_debate_continues)

Koene R, Boulware DR, Kemperman M, Konety SH, Groth M, Jessurun J, Eckman PM (2012) Acute heart failure from lyme carditis. *Circ Heart Fail.* 5(2), e24-6. doi: 10.1161/CIRCHEARTFAILURE.111.965533. <http://circheartfailure.ahajournals.org/content/5/2/e24.extract>

Kubánek M, Šramko M, Berenová D, Hulínská D, Hrbáčková H, Malušková J, Lodererová A, Málek I, Kautzner J (2012) Detection of *Borrelia burgdorferi* sensu lato in endomyocardial biopsy specimens in individuals with recent-onset dilated cardiomyopathy. *Eur J Heart Fail.* 14(6), 588-96. doi: 10.1093/eurjhf/hfs027. Epub 2012 Feb 29.  
<http://www.ncbi.nlm.nih.gov/m/pubmed/22379178/?i=48&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Maher B, Murday D, Harden SP (2012) Cardiac MRI of Lyme disease myocarditis. *Heart.* 98(3), 264. doi: 10.1136/heartjnl-2011-301070. Epub 2011 Nov 14. <http://heart.bmj.com/content/98/3/264.extract>

Centers for Disease Control and Prevention (CDC) (2013) Three sudden cardiac deaths associated with Lyme carditis - United States, November 2012-July 2013. *MMWR Morb Mortal Wkly Rep.* 62(49), 993-6. <http://www.ncbi.nlm.nih.gov/m/pubmed/24336130/?i=15&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Plocarová K (2013) Inflammatory borrelia - associated dilated cardiomyopathy. *Vnitr Lek.* 59(12), 107-10. [Article in Czech] <http://www.ncbi.nlm.nih.gov/pubmed/24350941>

Krause PJ, Bockenstedt LK (2013) Cardiology patient pages. Lyme disease and the heart. *Circulation.* 127(7), e451-4. doi:10.1161/CIRCULATIONAHA.112.101485. <http://circ.ahajournals.org/content/127/7/e451.full>

Nayak SU, Simon GL (2013) Myocarditis after trimethoprim/sulfamethoxazole treatment for ehrlichiosis. *Emerg Infect Dis.* 19(12), 1975-1977.

Deresinski S (2014) Sudden unexpected cardiac death from lyme disease. *J Infect Dis* 33, 37–9.

Fabian J, Brunner, Stefan Blankenberg, Karsten Sydow (2014) Digital camera revealed infection with *Borrelia burgdorferi* as a cause of reversible total AV block in a 42 year old man. *International Journal of Cardiology.* DOI:<http://dx.doi.org/10.1016/j.ijcard.2014.08.139>  
<http://www.internationaljournalofcardiology.com/article/S0167-5273%2814%2901686-6/abstract>

Puri BK, Shah M, Monro JA, Kingston MC, Julu PO (2014) Respiratory modulation of cardiac vagal tone in Lyme disease. *World J Cardiol.* 6(6), 502-6. doi: 10.4330/wjc.v6.i6.502.  
<http://www.ncbi.nlm.nih.gov/m/pubmed/24976922/?i=4&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

« Respiratory modulation of cardiac vagal tone is impaired in Lyme disease, which suggests that Lyme disease may directly affect the vagus nerve or the brainstem ».

Hegerova LT, Olson TC (2014) The ticking heart: a case and review of acute lyme cardiac complications. *Minn Med.* 97(5), 42.  
<http://www.ncbi.nlm.nih.gov/m/pubmed/24941591/?i=7&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Karatolios K, Maisch B, Pankuweit S (2014) Suspected inflammatory cardiomyopathy : Prevalence of *Borrelia burgdorferi* in endomyocardial biopsies with positive serological evidence. *Herz.*  
<http://www.ncbi.nlm.nih.gov/m/pubmed/24938220/?i=8&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Forrester JD, Mead P (2014) Third-Degree Heart Block Associated With Lyme Carditis: Review of Published Cases. *Clin Infect Dis.* pii: ciu411. 59(7), 996–1000  
<http://www.ncbi.nlm.nih.gov/m/pubmed/24879781/?i=9&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Forrester JD (2014) Recognizing Lyme Carditis. *CDC Expert Commentary*  
<http://www.medscape.com/viewarticle/818773>

Mannava K, Grabinski ZG, Mousa O (2014) Putting Heart Block Back in the „Lyme Light“. *Journal of Cardiology Cases.* <http://www.journalofcardiologycases.com/article/S1878-5409%2814%2900132-7/abstract>

« Learning objective: Although uncommon, Lyme carditis may present without any other classic signs or symptoms of Lyme disease. It should be considered in any patient who presents with new-onset atrioventricular heart block and a history of living in an endemic area. Prompt initiation of empiric antibiotic therapy can be both diagnostic and therapeutic».

Rojas-Martel G, Chadha S, Topi B, Hollander G, Shani J (2014) Heart block and Lyme carditis. *QJM.* 107(9), 771-2. doi: 10.1093/qjmed/hcu021. Epub 2014 Jan 27.  
<http://www.ncbi.nlm.nih.gov/m/pubmed/24472735/?i=14&from=%28Heart%20OR%20cardiac%29%20AND%20%28Lyme%20OR%20Borrelia>

Shenthathar J, Shetty SB, Krishnamurthy D (2014) Diagnosis not to be missed: Lyme carditis, rare but reversible cause of complete atrioventricular block. *Science direct.* doi:10.1016/j.ihj.2014.11.004

« We present a 43-year-old male who presented with complete heart block and also ill-sustained ventricular tachycardia due to Lyme carditis that reversed completely with antibiotic therapy. »

Gaaloul I, Riabi S, Harrath R et al. (2014) Coxsackievirus B detection in cases of myocarditis, myopericarditis, pericarditis and dilated cardiomyopathy in hospitalized patients. *Mol Med Rep.* 10(6), 2811-2818

Błaut-Jurkowska J, Olszowska M, Kaźnica-Wiatr M, Podolec P (2015) Lyme carditis. *Pol Merkur Lekarski.* 39(230), 111-5 <http://www.ncbi.nlm.nih.gov/pubmed/26319387>

Noyes AM, Kluger J (2015) A Tale of Two Syndromes: Lyme Disease Preceding Postural Orthostatic

Tachycardia Syndrome. *Ann Noninvasive Electrocardiol* 20(1), 82-86

<http://www.ncbi.nlm.nih.gov/pubmed/24830783>

«We report a short series of two women who present with persistent symptoms of orthostatic intolerance consistent with POTS after treated Lyme disease. «

Yoon E, Vail E, Kleinmann G et al. (2015) Lyme disease: A case report of a 17-year old male with fatal Lyme carditis. *Cardiovascular Pathology*.

<http://www.cardiovascularpathology.com/article/S1054-8807%2815%2900025-3/abstract>

<http://www.lymeneteurope.org/forum/viewtopic.php?f=5&t=5727>

Scheffold N, Herkommer B, Kandolf R, May AE (2015) Lyme carditis—diagnosis, treatment and prognosis. *Dtsch Arztebl Int* 2015; 112: 202–8. DOI: 10.3238/arztebl.2015.0202

<http://www.aerzteblatt.de/archiv/168828/Diagnostik-Therapie-und-Prognose-der-Lyme-Karditis>

<http://www.aerzteblatt.de/pdf/112/12/m202.pdf>

Muehlenbachs A, Bollweg BC, Schulz TJ et al. (2016) Cardiac Tropism of *Borrelia burgdorferi*: An Autopsy Study of Sudden Cardiac Death Associated with Lyme Carditis. *Am J Pathol.* 186(5), 1195–1205 pii: S0002-9440(16)00099-7. doi:10.1016/j.ajpath.2015.12.027. <http://www.ncbi.nlm.nih.gov/pubmed/26968341>

Kostić T, Momčilović S, Perišić ZD et al. (2016) Manifestations of Lyme carditis. *International journal of cardiology.* <http://dx.doi.org/10.1016/j.ijcard.2016.12.169>

[http://www.internationaljournalofcardiology.com/article/S0167-5273\(16\)34820-3/abstract](http://www.internationaljournalofcardiology.com/article/S0167-5273(16)34820-3/abstract)

Fuster LS, Gul EE, Baranchuk A (2017) Electrocardiographic progression of acute Lyme disease. *Science Direct.* DOI: <http://dx.doi.org/10.1016/j.ajem.2017.02.052>

[http://www.ajemjournal.com/article/S0735-6757\(17\)30165-1/abstract?cc=y](http://www.ajemjournal.com/article/S0735-6757(17)30165-1/abstract?cc=y)

Sharma AK, Almaddah N, Chaudhry K et al (2017) Without Further Delay: Lyme Carditis. *Am J Med.* pii: S0002-9343(17)31184-1. doi:10.1016/j.amjmed.2017.11.004.

Novak Ch, Harrison A, Aucott J (2017) Early Disseminated Lyme Disease with Carditis Complicated by Posttreatment Lyme Disease Syndrome. *Case Reports in Infectious Diseases* 2017 (2017), Article ID 5847156, 4 pages. <https://doi.org/10.1155/2017/5847156>

<https://www.hindawi.com/journals/criid/2017/5847156/>

US Centers for Disease Control. (2018) Parasites. Babesiosis. Resources for Health

Professionals. [https://www.cdc.gov/parasites/babesiosis/health\\_professionals/index.html](https://www.cdc.gov/parasites/babesiosis/health_professionals/index.html). Last updated July 19, 2013. Accessed August 28, 2018.

McGee M, Shiel E, Briennesse S, Murch S, Pickles R, Leitch J (2018) Staphylococcus aureus myocarditis with associated left ventricular apical thrombus. *Case Rep Cardiol.* 2018, 7017286.

Willis M (2018) FAQ of Types of Viruses and Bacteria that Cause Myocarditis. Myocarditis

Foundation. <https://www.myocarditisfoundation.org/research-and-grants/faqs/causes-of-myocarditis/>.

Accessed August 24, 2018

[Kannangara DW, Sidra S, Pritiben P \(2019\) First case report of inducible heart block in Lyme disease and an update of Lyme carditis. \*BMC Infect Dis.\* 19\(1\), 428. doi:10.1186/s12879-019-4025-0.](https://doi.org/10.1186/s12879-019-4025-0)

<https://www.ncbi.nlm.nih.gov/pubmed/31096922#>

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.13 Infiltrative, destructive, tumorous, auto neogenesis**

Russell W (1890) An address on a characteristic organism of cancer. *Br Med J.* 2, 1356-1360

Russell W (1899) The parasite of cancer. *Lancet.* 1, 1138-1141.

Hess D. (1997) *Can Bacteria Cause Cancer?* New York University Press. New York, USA

Wainwright M (1999) Nanobacteria and associated elementary bodies in human disease and cancer. *Microbiology* 145, 2623-2624

Enby EOH (1984) Mikroben ähnliche Bildungen im Blut bei chronischen Krankheiten. Microbe-like formations in the blood of patients with chronic diseases

<http://www.enby.se/deutsch/aufsatz/2/mikrobenahnliche-bildungen-im-blut-bei-chronischen-krankheiten.htm>

Cantwell Jr A (1990) *The Cancer Microbe. The hidden killer in Cancer, AIDS, and other Diseases.* Aries Rising Press Los Angeles. ISBN 0-917211-01-4

Enby EOH, Chouhan RS (1994) Microorganisms in blood and tumor tissue from patients with malignancies of breast or genital tract. Atypical microbes in blood and cancer tissue.

<http://www.enby.se/english/paper/6/microorganisms-in-blood-and-tumour-tissue-from-patients.htm#video>

Lamb R, Ozsvari B, Lisanti CL et al. (2015) Antibiotics that target mitochondria effectively eradicate cancer stem cells, across multiple tumor types: Treating cancer like an infectious disease. *Oncotarget*, p.1-16

<http://www.ncbi.nlm.nih.gov/pubmed/25625193>

Lamb R, Ozsvari B, Lisanti CL et al. (2015) Antibiotics that target mitochondria effectively eradicate cancer stem cells, across multiple tumor types: Treating cancer like an infectious disease. *Oncotarget*. 6, 4569-4584. doi: 10.18632/oncotarget.3174 [PDF](#) | [HTML](#) | [Order a Reprint](#)

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4467100/>

<http://www.impactjournals.com/oncotarget/index.php?journal=oncotarget&op=view&page=article&path%5B%5D=3174>

Kallick CA, Friedman DA, Nyindo MB (2015) Could ehrlichial infection cause some of the changes associated with leukemia, myelodysplastic diseases and autoimmune disorders, and offer antibiotic treatment options? *Med Hypotheses*. 85(6), 891-3. doi:10.1016/j.mehy.2015.09.015. Epub 2015 Sep 16.

<https://www.ncbi.nlm.nih.gov/pubmed/26394545>

Jacqueline C, Tasiemski A, Sorci G et al. (2017) Infections and cancer: the "fifty shades of immunity" hypothesis. *BMC Cancer*. 17(1), 257. doi: 10.1186/s12885-017-3234-4.

<https://www.ncbi.nlm.nih.gov/pubmed/28403812>

«Infectious organisms, that are not oncogenic neither oncolytic, may play a significant role in carcinogenesis, suggesting the need to increase our knowledge about immune interactions between infections and cancer.»

Dejea ChM, Fathi P, Craig JM et al. (2018) Patients with familial adenomatous polyposis harbor colonic biofilms containing tumorigenic bacteria. *Science* 359(6375), 592-597 DOI: 10.1126/science.aah3648

<http://science.sciencemag.org/content/359/6375/592>

« We identified patchy bacterial biofilms composed predominately of *Escherichia coli* and *Bacteroides fragilis*. ... These data suggest an unexpected link between early neoplasia of the colon and tumorigenic bacteria“.

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## [2.14](#) Laboratory tests and imaging procedures

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## [2.15](#) Special risks and contraindications, therapy options

Jolivet-Gougeon A, Kovacs B, Le Gall-David S, (2011) Bacterial hypermutation: clinical implications. *Journal of Medical Microbiology* 60, 563–573 <http://jmm.sgmjournals.org/content/60/5/563.abstract>

<http://www.ncbi.nlm.nih.gov/pubmed/21349992> [methyl-directed mismatch repair (MMR) system]

White B, Seaton RA, Evans TJ (2012) Management of suspected Lyme borreliosis: experience from an outpatient parenteral antibiotic therapy service. *QJM Advance Access*. 1-6

<http://www.ncbi.nlm.nih.gov/pubmed/23070203> [Ceftriaxon 21-23 Tage, maximal 43 Tage, Venenkatheter, 40% Nebenwirkungen]

Rashid MU, Lozano HM, Weintraub A et al. (2013) In vitro activity of cadazolid against *Clostridium difficile* strains isolated from primary and recurrent infections in Stockholm, Sweden. *Anaerobe*. pii: S1075-9964(13)00023-1. doi:10.1016/j.anaerobe.2013.02.003. <http://www.ncbi.nlm.nih.gov/pubmed/23454525>

Pena-Miller R, Laehnemann D, Jansen G, Fuentes-Hernandez A, Rosenstiel P, Schulenburg H, Beardmore R (2013) Research Article: When the Most Potent Combination of Antibiotics Selects for the Greatest Bacterial Load: The Smile-Frown Transition. *PLOS Biology* 11(4), e1001540, 1-13 [in vitro]

[http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1001540?utm\\_source=feedburner&utm\\_medium=feed&utm\\_campaign=Feed%3A+plosbiology%2FNewArticles+%28Ambra+-+Biology+New+Articles%29](http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1001540?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+plosbiology%2FNewArticles+%28Ambra+-+Biology+New+Articles%29)

Kalghatgi S et al. (2013) Bactericidal antibiotics induce mitochondrial dysfunction and oxidative damage in mammalian cells. *Science Translational Medicine*, 5, 192ra85

<http://stm.sciencemag.org/content/5/192/192ra85.short>

Klempner MS, Baker PJ, Shapiro ED, Marques A, Dattwyler RJ, Halperin JJ, Wormser GP (2013) [Treatment trials for post-Lyme disease symptoms revisited](#). *Am J Med*. 126(8) 665-9. doi:10.1016/j.amjmed.2013.02.014

Berghoff W (2014) Literaturübersicht Antibiotische Behandlung Lyme-Borreliose Stadium III

[http://www.praxis-berghoff.de/dokumente/berghoff150714/Kapitel\\_23-d\\_Literaturuebersicht\\_Antibiotische\\_Behandlung\\_LB\\_III.pdf](http://www.praxis-berghoff.de/dokumente/berghoff150714/Kapitel_23-d_Literaturuebersicht_Antibiotische_Behandlung_LB_III.pdf)

Lurie I, Yang YX, Haynes K, Mamtani R, Boursi B (2015) Antibiotic exposure and the risk for depression, anxiety, or psychosis: a nested case-control study. *J Clin Psychiatry*. 76(11), 1522-8. doi:



10.4088/JCP.15m09961. <https://www.ncbi.nlm.nih.gov/pubmed/26580313>

Nelson C, Elmendorf S, Mead P (2015) [Neoplasms misdiagnosed as "chronic Lyme disease"](#). JAMA Intern Med. 175, 132–133. 36.

Marks CM, Nawn JE, Caplow JA (2016) [Antibiotic treatment for chronic Lyme disease-Say no to the DRESS](#). JAMA Intern Med. 176(12), 1745-1746. . [Drug reaction with eosinophilia and systemic syndroms]

<https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/2571617?redirect=true>

Nemeth J, Bernasconi E, Heining U, Abbas M, Nadal D, Strahm C, Erb S, Zimmerli S, Furrer H, Delaloye J, Kuntzer T1, Altpeter E1, Sturzenegger M, Weber R (2016) For The Swiss Society For Infectious Diseases And The Swiss Society For Neurology. [Update of the Swiss guidelines on post-treatment Lyme disease syndrome](#). Swiss Med Wkly 146, w14353. doi: 10.4414/smw.2016.14353

[Marzec NS](#), [Nelson C](#), [Waldron PR](#) et al. (2017) Serious Bacterial Infections Acquired During Treatment of Patients Given a Diagnosis of Chronic Lyme Disease - United States. [MMWR Morb Mortal Wkly Rep](#). 66(23), 607-609. doi: 10.15585/mmwr.mm6623a3.

[https://www.ncbi.nlm.nih.gov/pubmed/28617768#cm28617768\\_69799](https://www.ncbi.nlm.nih.gov/pubmed/28617768#cm28617768_69799)

De Wilde M, Speeckaert M, Callens R, Van Biesen W (2017) [Ceftriaxone-induced immune hemolytic anemia as a life-threatening complication of antibiotic treatment of 'chronic Lyme disease'](#). Acta Clin Belg. 72(2), 133-137. doi: 10.1080/17843286.2016.1180829.

Weiter mit: [http://www.kabilahsystems.de/antibiotika\\_langzeit.pdf](http://www.kabilahsystems.de/antibiotika_langzeit.pdf)

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.16 Variants to combination – long-term – antibiotics & adjuvants**

[http://www.kabilahsystems.de/antibiotika\\_langzeit.pdf](http://www.kabilahsystems.de/antibiotika_langzeit.pdf)

[http://www.kabilahsystems.de/antibiotika\\_pulse.pdf](http://www.kabilahsystems.de/antibiotika_pulse.pdf)

Stricker RB, Delong AK, Green CL, Savely VR, Chamallas SN, Johnson L (2011) [Benefit of intravenous antibiotic therapy in patients referred for treatment of neurologic Lyme disease](#). Int J Gen Med. 4, 639–646.

Berende A, ter Hofstede HJ, Vos FJ, van Middendorp H, Vogelaar ML, Tromp M, van den Hoogen FH, Donders AR, Evers AW, Kullberg BJ (2016) [Randomized Trial of Longer-Term Therapy for Symptoms Attributed to Lyme Disease](#). N Engl J Med. 374(13), 1209-20. doi: 10.1056/NEJMoa1505425

[Back](#)

Windows Alt + left arrow  
Apple to start Fn + left arrow

## **2.17 Comment on the fees**

In the preparation of the fees, the services provided and the special circumstances of the provision of services, the special orders by the patient as well as the economic situation of the patient are taken into account.