

REFERENCES

- Adam EC, Mitchell BS, Schumacher DU, Grant G, Schumacher U (1997) *Pseudomonas aeruginosa* II lectin stops human ciliary beating: therapeutic implications of fucose. *Am J Respir Crit Care Med.* 155:2102-2104. doi: 10.1164/ajrccm.155.6.9196121
- Aiba H (2007) Mechanism of RNA silencing by Hfq-binding small RNAs. *Curr Opin Microbiol.* 10:134-139. doi: 10.1016/j.mib.2007.03.010
- Arnvig K, Young D (2012) Non-coding RNA and its potential role in *Mycobacterium tuberculosis* pathogenesis. *RNA Biol.* 9:427-436. doi: 10.4161/rna.20105
- Backofen R, Hess WR (2010) Computational prediction of sRNAs and their targets in bacteria. *RNA Biol.* 7:33-42. doi: 10.4161/rna.7.1.10655
- Balasubramanian D, Schnepfer L, Kumari H, Mathee K (2013) A dynamic and intricate regulatory network determines *Pseudomonas aeruginosa* virulence. *Nucleic Acids Res.* 41:1-20. doi: 10.1093/nar/gks1039. Epub 2012 Nov 11.
- Bardill JP, Zhao X, Hammer BK (2011) The *Vibrio cholerae* quorum sensing response is mediated by Hfq-dependent sRNA/mRNA base pairing interactions. *Mol Microbiol.* 80:1381-1394. doi: <https://doi.org/10.1111/j.1365-2958.2011.07655.x>
- Barquist L, Vogel J (2015) Accelerating Discovery and Functional Analysis of Small RNAs with New Technologies. *Annu Rev Genet.* 49:367-394. doi: 10.1146/annurev-genet-112414-054804
- Ben Haj Khalifa A, Moissenet D, Vu Thien H, Khedher M (2011) [Virulence factors in *Pseudomonas aeruginosa*: mechanisms and modes of regulation]. *Ann Biol Clin (Paris).* 69:393-403. doi: 10.1684/abc.2011.0589
- Bjarnsholt T, Givskov M (2007) The role of quorum sensing in the pathogenicity of the cunning aggressor *Pseudomonas aeruginosa*. *Anal Bioanal Chem.* 387:409-414. doi: 10.1007/s00216-006-0774-x
- Bjarnsholt T, Jensen PØ, Jakobsen TH, Phipps R, Nielsen AK, Rybtke MT, et al. (2010) Quorum sensing and virulence of *Pseudomonas aeruginosa* during lung infection of cystic fibrosis patients. *PLoS One.* 5:doi: <https://doi.org/10.1371/journal.pone.0010115>
- Bloch S, Węgrzyn A, Węgrzyn G, Nejman-Faleńczyk B (2017) Small and Smaller-sRNAs and MicroRNAs in the Regulation of Toxin Gene Expression in Prokaryotic Cells: A Mini-Review. *Toxins (Basel).* 9:doi: 10.3390/toxins9060181
- Bobrovskyy M, Vanderpool CK (2013) Regulation of bacterial metabolism by small RNAs using diverse mechanisms. *Annu Rev Genet.* 47:209-232. doi: 10.1146/annurev-genet-111212-133445
- Bobrovskyy M, Vanderpool CK (2016) Diverse mechanisms of post-transcriptional repression by the small RNA regulator of glucose-phosphate stress. *Mol Microbiol.* 99:254-273. doi: 10.1111/mmi.13230

- Bordeau V, Cady A, Revest M, Rostan O, Sassi M, Tattevin P, et al. (2016) Staphylococcus aureus Regulatory RNAs as Potential Biomarkers for Bloodstream Infections. *Emerg Infect Dis.* 22:1570-1578. doi: 10.3201/eid2209.151801
- Bradley ES, Bodi K, Ismail AM, Camilli A (2011) A genome-wide approach to discovery of small RNAs involved in regulation of virulence in *Vibrio cholerae*. *PLoS Pathog.* 7:e1002126. doi: 10.1371/journal.ppat.1002126
- Busch A, Richter AS, Backofen R (2008) IntaRNA: efficient prediction of bacterial sRNA targets incorporating target site accessibility and seed regions. *Bioinformatics.* 24:2849-2856. doi: btn544 [pii]10.1093/bioinformatics/btn544
- Caldelari I, Chao Y, Romby P, Vogel J (2013) RNA-Mediated Regulation in Pathogenic Bacteria. *Cold Spring Harb Perspect Med.* 3:doi: 10.1101/cshperspect.a010298
- Caldwell CC, Chen Y, Goetzmann HS, Hao Y, Borchers MT, Hassett DJ, et al. (2009) *Pseudomonas aeruginosa* exotoxin pyocyanin causes cystic fibrosis airway pathogenesis. *Am J Pathol.* 175:2473-2488. doi: <https://doi.org/10.2353/ajpath.2009.090166>
- Cao Y, Zhao Y, Cha L, Ying X, Wang L, Shao N, et al. (2009) sRNATarget: a web server for prediction of bacterial sRNA targets. *Bioinformation.* 3:364-366.
- Carlioni S, Macchi R, Sattin S, Ferrara S, Bertoni G (2017) The small RNA ReaL: a novel regulatory element embedded in the *Pseudomonas aeruginosa* quorum sensing networks. *Environ Microbiol.* 19:4220-4237. doi: 10.1111/1462-2920.13886
- Caswell CC, Gaines JM, Ciborowski P, Smith D, Borchers CH, Roux CM, et al. (2012) Identification of two small regulatory RNAs linked to virulence in *Brucella abortus* 2308. *Mol Microbiol.* 85:345-360. doi: 10.1111/j.1365-2958.2012.08117.x. Epub 2012 Jun 12
- Chabelskaya S, Bordeau V, Felden B (2014) Dual RNA regulatory control of a *Staphylococcus aureus* virulence factor. *Nucleic Acids Res.* 42:4847-4858. doi: 10.1093/nar/gku119
- Chabelskaya S, Gaillot O, Felden B (2010) A *Staphylococcus aureus* small RNA is required for bacterial virulence and regulates the expression of an immune-evasion molecule. *PLoS Pathog.* 6:e1000927. doi: 10.1371/journal.ppat.1000927
- Chambers JR, Sauer K (2013) Small RNAs and their role in biofilm formation. *Trends Microbiol.* 21:39-49. doi: 10.1016/j.tim.2012.10.008
- Chao Y, Papenfort K, Reinhardt R, Sharma CM, Vogel J (2012) An atlas of Hfq-bound transcripts reveals 3' UTRs as a genomic reservoir of regulatory small RNAs. *EMBO J.* 31:4005-4019. doi: 10.1038/emboj.2012.229. Epub 2012 Aug 24
- Chen Y, Indurthi DC, Jones SW, Papoutsakis ET (2011) Small RNAs in the genus *Clostridium*. *MBio.* 2:e00340-00310. doi: 10.1128/mBio.00340-10
- Choi JW, Um JH, Cho JH, Lee HJ (2017) Tiny RNAs and their voyage via extracellular vesicles: Secretion of bacterial small RNA and eukaryotic microRNA. *Exp Biol Med (Maywood).* 242:1475-1481. doi: 10.1177/1535370217723166

Choi KH, Kumar A, Schweizer HP (2006) A 10-min method for preparation of highly electrocompetent *Pseudomonas aeruginosa* cells: application for DNA fragment transfer between chromosomes and plasmid transformation. *J Microbiol Methods*. 64:391-397.

Chomczynski P, Sacchi N (2006) The single-step method of RNA isolation by acid guanidinium thiocyanate-phenol-chloroform extraction: twenty-something years on. *Nat Protoc*. 1:581-585.

Christiansen JK, Nielsen JS, Ebersbach T, Valentin-Hansen P, Søgaaard-Andersen L, Kallipolitis BH (2006) Identification of small Hfq-binding RNAs in *Listeria monocytogenes*. *RNA*. 12:1383-1396. doi: 10.1261/rna.49706

Conibear TC, Willcox MD, Flanagan JL, Zhu H (2012) Characterization of protease IV expression in *Pseudomonas aeruginosa* clinical isolates. *J Med Microbiol*. 61:180-190. doi: 10.1099/jmm.0.034561-0

De Lay N, Schu DJ, Gottesman S (2013) Bacterial small RNA-based negative regulation: Hfq and its accomplices. *J Biol Chem*. 288:7996-8003. doi: 10.1074/jbc.R112.441386

Dekimpe V, Déziel E (2009) Revisiting the quorum-sensing hierarchy in *Pseudomonas aeruginosa*: the transcriptional regulator RhlR regulates LasR-specific factors. *Microbiology*. 155:712-723. doi: 10.1099/mic.0.022764-0

Dersch P, Khan MA, Mühlen S, Görke B (2017) Roles of Regulatory RNAs for Antibiotic Resistance in Bacteria and Their Potential Value as Novel Drug Targets. *Front Microbiol*. 5:doi: 10.3389/fmicb.2017.00803. eCollection 2017.

Diggle SP, Winzer K, Chhabra SR, Worrall KE, Cámara M, Williams P (2003) The *Pseudomonas aeruginosa* quinolone signal molecule overcomes the cell density-dependency of the quorum sensing hierarchy, regulates rhl-dependent genes at the onset of stationary phase and can be produced in the absence of LasR. *Mol Microbiol*. 50:29-43.

Durand S, Braun F, Helfer AC, Romby P, Condon C (2017) sRNA-mediated activation of gene expression by inhibition of 5'-3' exonucleolytic mRNA degradation. *Elife*. 24:doi: 10.7554/eLife.23602

Durand S, Storz G (2010) Reprogramming of anaerobic metabolism by the FnrS small RNA. *Mol Microbiol*. 75:1215-1231. doi: 10.1111/j.1365-2958.2010.07044.x.

Eggenhofer F, Tafer H, Stadler PF, Hofacker IL (2011) RNApredator: fast accessibility-based prediction of sRNA targets. *Nucleic Acids Res*. 39:doi: 10.1093/nar/gkr467

Eyraud A, Tattevin P, Chabelskaya S, Felden B (2014) A small RNA controls a protein regulator involved in antibiotic resistance in *Staphylococcus aureus*. *Nucleic Acids Res*. 42:4892-4905. doi: 10.1093/nar/gku149

Falcone M, Ferrara S, Rossi E, Johansen HK, Molin S, Bertoni G (2018) The Small RNA ErsA of *Pseudomonas aeruginosa* Contributes to Biofilm Development and Motility through Post-transcriptional Modulation of AmrZ. *Front Microbiol*. 9:doi: 10.3389/fmicb.2018.00238. eCollection 2018.

- Fechter P, Caldelari I, Lioliou E, Romby P (2014) Novel aspects of RNA regulation in *Staphylococcus aureus*. *FEBS Lett.* 588:2523-2529. doi: 10.1016/j.febslet.2014.05.037
- Feng L, Rutherford ST, Papenfort K, Bagert JD, van Kessel JC, Tirrell DA, et al. (2015) A qrr noncoding RNA deploys four different regulatory mechanisms to optimize quorum-sensing dynamics. *Cell.* 160:228-240. doi: 10.1016/j.cell.2014.11.051
- Ferrara S, Carloni S, Fulco R, Falcone M, Macchi R, Bertoni G (2015) Post-transcriptional regulation of the virulence-associated enzyme AlgC by the $\sigma(22)$ -dependent small RNA ErsA of *Pseudomonas aeruginosa*. *Environ Microbiol.* 17:doi: 10.1111/1462-2920.12590. Epub 2014 Sep 3.
- Folkesson A, Jelsbak L, Yang L, Johansen H, Ciofu O, Hoiby N, et al. (2012) Adaptation of *Pseudomonas aeruginosa* to the cystic fibrosis airway: an evolutionary perspective. *Nat Rev Microbiol.* 10:841-851. doi: nrmicro2907 [pii] 10.1038/nrmicro2907
- Fröhlich K, S., Papenfort K, Fekete A, Vogel J (2013) A small RNA activates CFA synthase by isoform-specific mRNA stabilization. *EMBO J.* 32:2963-2979. doi: 10.1038/emboj.2013.222
- Frohlich KS, Haneke K, Papenfort K, Vogel J (2016) The target spectrum of SdsR small RNA in *Salmonella*. *Nucleic Acids Res.* 44:10406-10422. doi: 10.1093/nar/gkw632
- Gelsinger DR, DiRuggiero J (2018) Transcriptional Landscape and Regulatory Roles of Small Noncoding RNAs in the Oxidative Stress Response of the Haloarchaeon *Haloferax volcanii*. *J Bacteriol.* 200:doi: 10.1128/JB.00779-17
- Ghosh S, Dureja C, Khatri I, Subramanian S, Raychaudhuri S, Ghosh S (2017) Identification of novel small RNAs in *Burkholderia cenocepacia* KC-01 expressed under iron limitation and oxidative stress conditions. *Microbiology.* doi: 10.1099/mic.0.000566
- Gilbert KB, Kim TH, Gupta R, Greenberg EP, Schuster M (2009) Global position analysis of the *Pseudomonas aeruginosa* quorum-sensing transcription factor LasR. *Mol Microbiol.* 73:1072-1085. doi: 10.1111/j.1365-2958.2009.06832.x
- Gimpel M, Brantl S (2017) Dual-function small regulatory RNAs in bacteria. *Mol Microbiol.* 103:387-397. doi: 10.1111/mmi.13558
- Gong H, Vu GP, Bai Y, Chan E, Wu R, Yang E, et al. (2011) A *Salmonella* small non-coding RNA facilitates bacterial invasion and intracellular replication by modulating the expression of virulence factors. *PLoS Pathog.* 7:doi: 10.1371/journal.ppat.1002120
- Gonzalez N, Heeb S, Valverde C, Kay E, Reimann C, Junier T, et al. (2008) Genome-wide search reveals a novel GacA-regulated small RNA in *Pseudomonas* species. *BMC Genomics.* 9:167. doi: 10.1186/1471-2164-9-167
- Gottesman S, Storz G (2011) Bacterial small RNA regulators: versatile roles and rapidly evolving variations. *Cold Spring Harb Perspect Biol.* 3:doi: cshperspect.a003798 [pii] 10.1101/cshperspect.a003798
- Halfmann A, Kovacs M, Hakenbeck R, Bruckner R (2007) Identification of the genes directly controlled by the response regulator CiaR in *Streptococcus pneumoniae*: five out of 15

promoters drive expression of small non-coding RNAs. *Mol Microbiol.* 66:110-126. doi: 10.1111/j.1365-2958.2007.05900.x

Hall S, McDermott C, Anoopkumar-Dukie S, McFarland AJ, Forbes A, Perkins AV, et al. (2016) Cellular Effects of Pyocyanin, a Secreted Virulence Factor of *Pseudomonas aeruginosa*. *Toxins (Basel)*. 8:doi: 10.3390/toxins8080236

Hammer BK, Bassler BL (2007) Regulatory small RNAs circumvent the conventional quorum sensing pathway in pandemic *Vibrio cholerae*. *Proc Natl Acad Sci U S A.* 104:11145-11149. doi: 10.1073/pnas.0703860104

Hébrard M, Kröger C, Srikumar S, Colgan A, Händler K, Hinton JC (2012) sRNAs and the virulence of *Salmonella enterica* serovar Typhimurium. *RNA Biol.* 9:437-445. doi: 10.4161/rna.20480

Heroven AK, Bohme K, Dersch P (2012) The Csr/Rsm system of *Yersinia* and related pathogens: a post-transcriptional strategy for managing virulence. *RNA Biol.* 9:379-391. doi: 10.4161/rna.19333

Hobden JA (2002) *Pseudomonas aeruginosa* proteases and corneal virulence. *DNA Cell Biol.* 21:391-396. doi: 10.1089/10445490260099674

Holloway BW (1955) Genetic recombination in *Pseudomonas aeruginosa*. *J Gen Microbiol.* 13:572-581. doi: 10.1099/00221287-13-3-572

Holmqvist E, Reimegard J, Sterk M, Grantcharova N, Romling U, Wagner EG (2010) Two antisense RNAs target the transcriptional regulator CsgD to inhibit curli synthesis. *EMBO J.* 29:1840-1850. doi: 10.1038/emboj.2010.73

Holmqvist E, Wagner EGH (2017) Impact of bacterial sRNAs in stress responses. *Biochem Soc Trans.* 45:1203-1212. doi: 10.1042/BST20160363

Hutadilok-Towatana N, Painupong A, Suntainalert P (1999) Purification and characterization of an extracellular protease from alkaliphilic and thermophilic *Bacillus* sp. PS719. *J Biosci Bioeng.* 87:581-587.

Jackson DW, Suzuki K, Oakford L, Simecka JW, Hart ME, Romeo T (2002) Biofilm formation and dispersal under the influence of the global regulator CsrA of *Escherichia coli*. *J Bacteriol.* 184:290-301.

Janssen KH, Diaz MR, Gode CJ, Wolfgang MC, Yahr TL (2018) RsmV, a Small Noncoding Regulatory RNA in *Pseudomonas aeruginosa* That Sequesters RsmA and RsmF from Target mRNAs. *J Bacteriol.* 200:doi: 10.1128/JB.00277-18. Print 2018 Aug 15.

Jensen V, Löns D, Zaoui C, Bredenbruch F, Meissner A, Dieterich G, et al. (2006) RhIR expression in *Pseudomonas aeruginosa* is modulated by the *Pseudomonas* quinolone signal via PhoB-dependent and -independent pathways. *J Bacteriol.* 188:8601-8606.

Jorgensen MG, Nielsen JS, Boysen A, Franch T, Moller-Jensen J, Valentin-Hansen P (2012) Small regulatory RNAs control the multi-cellular adhesive lifestyle of *Escherichia coli*. *Mol Microbiol.* 84:36-50. doi: 10.1111/j.1365-2958.2012.07976.x

- Jorgensen MG, Thomason MK, Havelund J, Valentin-Hansen P, Storz G (2013) Dual function of the McaS small RNA in controlling biofilm formation. *Genes Dev.* 27:1132-1145. doi: 10.1101/gad.214734.113
- Juhas M, Eberl L, B. T (2005) Quorum sensing: the power of cooperation in the world of *Pseudomonas*. *Environ Microbiol.* 7:459-471. doi: 10.1111/j.1462-2920.2005.00769.x
- Jyot J, Balloy V, Jouvion G, Verma A, Touqui L, Huerre M, et al. (2011) Type II secretion system of *Pseudomonas aeruginosa*: in vivo evidence of a significant role in death due to lung infection. *J Infect Dis.* 203:1369-1377. doi: 10.1093/infdis/jir045
- Kathirvel M, Buchad H, Nair M (2016) Enhancement of the pathogenicity of *Staphylococcus aureus* strain Newman by a small noncoding RNA SprX1. *Med Microbiol Immunol.* 205:563-574. doi: 10.1007/s00430-016-0467-9
- Kavita K, de Mets F, Gottesman S (2017) New aspects of RNA-based regulation by Hfq and its partner sRNAs. *Curr Opin Microbiol.* 42:53-61. doi: 10.1016/j.mib.2017.10.014.
- Kay E, Humair B, Dénervaud V, Riedel K, Spahr S, Eberl L, et al. (2006) Two GacA-dependent small RNAs modulate the quorum-sensing response in *Pseudomonas aeruginosa*. *J Bacteriol.* 188:6026-6033.
- Kery MB, Feldman M, Livny J, Tjaden B (2014) TargetRNA2: identifying targets of small regulatory RNAs in bacteria. *Nucleic Acids Res.* 42:W124-129. doi: gku317 [pii] 10.1093/nar/gku317
- Khan MA, Gopel Y, Milewski S, Gorke B (2016) Two Small RNAs Conserved in Enterobacteriaceae Provide Intrinsic Resistance to Antibiotics Targeting the Cell Wall Biosynthesis Enzyme Glucosamine-6-Phosphate Synthase. *Front Microbiol.* 7:908. doi: 10.3389/fmicb.2016.00908
- Klenk M, Koczan D, Guthke R, Nakata M, Thiesen HJ, Podbielski A, et al. (2005) Global epithelial cell transcriptional responses reveal *Streptococcus pyogenes* Fas regulator activity association with bacterial aggressiveness. *Cell Microbiol.* 7:1237-1250. doi: 10.1111/j.1462-5822.2005.00548.x
- Klockgether J, Munder A, Neugebauer J, Davenport CF, Stanke F, Larbig KD, et al. (2010) Genome diversity of *Pseudomonas aeruginosa* PAO1 laboratory strains. *J Bacteriol.* 192:1113-1121. doi: 10.1128/JB.01515-09
- Kovach ME, Elzer PH, Hill DS, Robertson GT, Farris MA, Roop RM, et al. (1995) Four new derivatives of the broad-host-range cloning vector pBBR1MCS, carrying different antibiotic-resistance cassettes. *Gene.* 166:175-176. doi: 0378111995005841 [pii]
- Kozak M (2005) Regulation of translation via mRNA structure in prokaryotes and eukaryotes. *Gene.* 361:13-37. doi: 10.1016/j.gene.2005.06.037
- Kulasekara HD, Ventre I, Kulasekara BR, Lazdunski A, Filloux A, Lory S (2005) A novel two-component system controls the expression of *Pseudomonas aeruginosa* fimbrial cup genes. *Mol Microbiol.* 55:368-380. doi: 10.1111/j.1365-2958.2004.04402.x

- Kwenda S, Gorshkov V, Ramesh AM, Naidoo S, Rubagotti E, Birch PR, et al. (2016) Discovery and profiling of small RNAs responsive to stress conditions in the plant pathogen *Pectobacterium atrosepticum*. *BMC Genomics*. 17:47. doi: 10.1186/s12864-016-2376-0
- Laarman AJ, Bardoel BW, Ruyken M, Fernie J, Milder FJ, van Strijp JA, et al. (2012) *Pseudomonas aeruginosa* alkaline protease blocks complement activation via the classical and lectin pathways. *J Immunol*. 188:386-393. doi: 10.4049/jimmunol.1102162
- Latifi A, Foglino M, Tanaka K, Williams P, Lazdunski A (1996) A hierarchical quorum-sensing cascade in *Pseudomonas aeruginosa* links the transcriptional activators LasR and RhIR (VsmR) to expression of the stationary-phase sigma factor RpoS. *Mol Microbiol*. 21:1137-1146. doi: <https://doi.org/10.1046/j.1365-2958.1996.00063.x>
- Lau GW, Hassett DJ, Ran H, Kong F (2004) The role of pyocyanin in *Pseudomonas aeruginosa* infection. *Trends Mol Med*. 10:599-606. doi: 10.1016/j.molmed.2004.10.002
- Leclerc JM, Dozois CM, Daigle F (2013) Role of the *Salmonella enterica* serovar Typhi Fur regulator and small RNAs RfrA and RfrB in iron homeostasis and interaction with host cells. *Microbiology*. 159:591-602. doi: 10.1099/mic.0.064329-0
- Lee J, Wu J, Deng Y, Wang J, Wang C, Wang J, et al. (2013) A cell-cell communication signal integrates quorum sensing and stress response. *Nat Chem Biol*. 9:339-343. doi: 10.1038/nchembio.1225
- Lee J, Zhang L (2015) The hierarchy quorum sensing network in *Pseudomonas aeruginosa*. *Protein Cell*. 6:26-41. doi: 10.1007/s13238-014-0100-x
- Lee SY, Bailey SC, Apirion D (1978) Small stable RNAs from *Escherichia coli*: evidence for the existence of new molecules and for a new ribonucleoprotein particle containing 6S RNA. *J Bacteriol*. 133:1015-1023.
- Lenz DH, Miller MB, Zhu J, Kulkarni RV, Bassler BL (2005) CsrA and three redundant small RNAs regulate quorum sensing in *Vibrio cholerae*. *Mol Microbiol*. 58:1186-1202. doi: 10.1111/j.1365-2958.2005.04902.x
- Lenz DH, Mok KC, Lilley BN, Kulkarni RV, Wingreen NS, Bassler BL (2004) The small RNA chaperone Hfq and multiple small RNAs control quorum sensing in *Vibrio harveyi* and *Vibrio cholerae*. *Cell*. 118:69-82. doi: 10.1016/j.cell.2004.06.009 S0092867404005732 [pii]
- Lesic B, Rahme LG (2008) Use of the lambda Red recombinase system to rapidly generate mutants in *Pseudomonas aeruginosa*. *BMC Mol Biol*. 9:doi: 10.1186/1471-2199-9-20.
- Lesinger T, Haas D, Hegarty MP (1972) Indospicine as an arginine antagonist in *Escherichia coli* and *Pseudomonas aeruginosa*. *Biochim Biophys Acta*. 262:214-219.
- Levine E, Hwa T (2008) Small RNAs establish gene expression thresholds. *Curr Opin Microbiol*. 11:574-579. doi: 10.1016/j.mib.2008.09.016
- Li W, Ying X, Lu Q, Chen L (2012) Predicting sRNAs and Their Targets in Bacteria. *Genomics Proteomics Bioinformatics*. 10:276-284. doi: 10.1016/j.gpb.2012.09.004

- Liu JM, Camilli A (2010) A broadening world of bacterial small RNAs. *Curr Opin Microbiol.* 13:18-23. doi: 10.1016/j.mib.2009.11.004
- Liu JM, Livny J, Lawrence MS, Kimball MD, Waldor MK, Camilli A (2009) Experimental discovery of sRNAs in *Vibrio cholerae* by direct cloning, 5S/tRNA depletion and parallel sequencing. *Nucleic Acids Res.* 37:doi: 10.1093/nar/gkp080
- Liu Z, Trevino J, Ramirez-Pena E, Sumbly P (2012) The small regulatory RNA FasX controls pilus expression and adherence in the human bacterial pathogen group A *Streptococcus*. *Mol Microbiol.* 86:140-154. doi: 10.1111/j.1365-2958.2012.08178.x
- Livak KJ, Schmittgen TD (2001) Analysis of relative gene expression data using real-time quantitative PCR and the 2⁻(Delta Delta C(T)) Method. *Methods.* 25:402-408.
- Livny J (2012) Bioinformatic discovery of bacterial regulatory RNAs using SIPHT. *Methods Mol Biol.* 905:3-14. doi: 10.1007/978-1-61779-949-5_1
- Livny J, Brencic A, Lory S, Waldor MK (2006) Identification of 17 *Pseudomonas aeruginosa* sRNAs and prediction of sRNA-encoding genes in 10 diverse pathogens using the bioinformatic tool sRNAPredict2. *Nucleic Acids Res.* 34:3484-3493. doi: 10.1093/nar/gkl453
- Long J, Zaborina O, Holbrook C, Zaborin A, Alverdy J (2008) Depletion of intestinal phosphate after operative injury activates the virulence of *P aeruginosa* causing lethal gut-derived sepsis. *Surgery.* 144:189-197. doi: 10.1016/j.surg.2008.03.045
- Lu P, Wang Y, Zhang Y, Hu Y, Thompson KM, Chen S (2016) RpoS-dependent sRNA RgsA regulates Fis and AcpP in *Pseudomonas aeruginosa*. *Mol Microbiol.* 102:244-259. doi: 10.1111/mmi.13458
- Lybecker MC, Samuels DS (2007) Temperature-induced regulation of RpoS by a small RNA in *Borrelia burgdorferi*. *Mol Microbiol.* 64:1075-1089. doi: 10.1111/j.1365-2958.2007.05716.x
- Lyczak JB, Cannon CL, Pier GB (2000) Establishment of *Pseudomonas aeruginosa* infection: lessons from a versatile opportunist. *Microbes Infect.* 2:1051-1060.
- Mangold M, Siller M, Roppenser B, Vlaminckx BJ, Penfound TA, Klein R, et al. (2004) Synthesis of group A streptococcal virulence factors is controlled by a regulatory RNA molecule. *Mol Microbiol.* 53:1515-1527. doi: 10.1111/j.1365-2958.2004.04222.x
- Mao C, Evans C, Jensen RV, Sobral BW (2008) Identification of new genes in *Sinorhizobium meliloti* using the Genome Sequencer FLX system. *BMC Microbiol.* . 8:doi: 10.1186/1471-2180-8-72
- Massé E, Vanderpool CK, Gottesman S (2005) Effect of RyhB Small RNA on Global Iron Use in *Escherichia coli*. *J Bacteriol.* 187:6962-6971. doi: 10.1128/JB.187.20.6962-6971.2005
- McEwan DL, Kirienko NV, Ausubel FM (2012) Host translational inhibition by *Pseudomonas aeruginosa* Exotoxin A Triggers an immune response in *Caenorhabditis elegans*. *Cell Host Microbe.* 11:364-374. doi: 10.1016/j.chom.2012.02.007

- McPhee JB, Bains M, Winsor G, Lewenza S, Kwasnicka A, Brazas MD, et al. (2006) Contribution of the PhoP-PhoQ and PmrA-PmrB two-component regulatory systems to Mg²⁺-induced gene regulation in *Pseudomonas aeruginosa*. *J Bacteriol.* 188:3995-4006. doi: 10.1128/JB.00053-06
- Medina G, Juárez K, Díaz R, Soberón-Chávez G (2003) Transcriptional regulation of *Pseudomonas aeruginosa* rhlR, encoding a quorum-sensing regulatory protein. *Microbiology.* 149:3073-3081.
- Melamed S, Peer A, Faigenbaum-Romm R, Gatt YE, Reiss N, Bar A, et al. (2016) Global Mapping of Small RNA-Target Interactions in Bacteria. *Mol Cell.* 63:884-897. doi: 10.1016/j.molcel.2016.07.026
- Mellin JR, Cossart P (2012) The non-coding RNA world of the bacterial pathogen *Listeria monocytogenes*. *RNA Biol.* 9:372-378. doi: 10.4161/rna.19235
- Michaux C, Verneuil N, Hartke A, Giard JC (2014) Physiological roles of small RNA molecules. *Microbiology.* 160:1007-1019. doi: mic.0.076208-0 [pii]10.1099/mic.0.076208-0
- Mika F, Busse S, Possling A, Berkholtz J, Tschowri N, Sommerfeldt N, et al. (2012) Targeting of *csgD* by the small regulatory RNA RprA links stationary phase, biofilm formation and cell envelope stress in *Escherichia coli*. *Mol Microbiol.* 84:51-65. doi: 10.1111/j.1365-2958.2012.08002.x
- Miller CL, Romero M, Karna SL, Chen T, Heeb S, Leung KP (2016) RsmW, *Pseudomonas aeruginosa* small non-coding RsmA-binding RNA upregulated in biofilm versus planktonic growth conditions. *BMC Microbiol.* 16:155. doi: 10.1186/s12866-016-0771-y
- Miller JH (1972). *Experiments in molecular genetics.* Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY
- Mizuno T, Chou MY, Inouye M (1984) A unique mechanism regulating gene expression: translational inhibition by a complementary RNA transcript (micRNA). *Proc Natl Acad Sci U S A.* 81:1966-1970.
- Mochizuki Y, Suzuki T, Oka N, Zhang Y, Hayashi Y, Hayashi N, et al. (2014) *Pseudomonas aeruginosa* MucD protease mediates keratitis by inhibiting neutrophil recruitment and promoting bacterial survival. *Invest Ophthalmol Vis Sci.* 55:240-246. doi: 10.1167/iovs.13-13151
- Monteiro C, Papenfort K, Hentrich K, Ahmad I, Le Guyon S, Reimann R, et al. (2012) Hfq and Hfq-dependent small RNAs are major contributors to multicellular development in *Salmonella enterica* serovar Typhimurium. *RNA Biol.* 9:489-502. doi: 10.4161/rna.19682
- Moon K, Gottesman S (2009) A PhoQ/P-regulated small RNA regulates sensitivity of *Escherichia coli* to antimicrobial peptides. *Mol Microbiol.* 74:1314-1330. doi: 10.1111/j.1365-2958.2009.06944.x
- Morfeldt E, Taylor D, von Gabain A, Arvidson S (1995) Activation of alpha-toxin translation in *Staphylococcus aureus* by the trans-encoded antisense RNA, RNAlII. *EMBO J.* 14:4569-4577.

- Morita T, Mochizuki Y, Aiba H (2006) Translational repression is sufficient for gene silencing by bacterial small noncoding RNAs in the absence of mRNA destruction. *Proc Natl Acad Sci U S A.* 103:4858-4863. doi: 10.1073/pnas.0509638103
- Mraheil MA, Billion A, Kuenne C, Pischmarov J, Kreikemeyer B, Engelmann S, et al. (2010a) Comparative genome-wide analysis of small RNAs of major Gram-positive pathogens: from identification to application. *Microb Biotechnol.* 3:658-676. doi: 10.1111/j.1751-7915.2010.00171.x
- Mraheil MA, Billion A, Kuenne C, Pischmarov J, Kreikemeyer B, Engelmann S, et al. (2010b) Comparative genome-wide analysis of small RNAs of major Gram-positive pathogens: from identification to application. *Microb Biotechnol.* 3:658-676. doi: 10.1111/j.1751-7915.2010.00171.x.
- Muckstein U, Tafer H, Hackermuller J, Bernhart SH, Stadler PF, Hofacker IL (2006) Thermodynamics of RNA-RNA binding. *Bioinformatics.* 22:1177-1182. doi: btl024 [pii]10.1093/bioinformatics/btl024
- Murphy ER, Payne SM (2007) RyhB, an iron-responsive small RNA molecule, regulates *Shigella dysenteriae* virulence. *Infect Immun.* 75:3470-3477. doi: 10.1128/IAI.00112-07
- Nguyen AN, Jacq A (2014) Small RNAs in the Vibrionaceae: an ocean still to be explored. *Wiley Interdiscip Rev RNA.* 5:381-392. doi: 10.1002/wrna.1218
- Nitzan M, Rehani R, Margalit H (2017) Integration of Bacterial Small RNAs in Regulatory Networks. *Annu Rev Biophys.* 46:131-148. doi: 10.1146/annurev-biophys-070816-034058
- Novick RP, Ross HF, Projan SJ, Kornblum J, Kreiswirth B, Moghazeh S (1993) Synthesis of staphylococcal virulence factors is controlled by a regulatory RNA molecule. *EMBO J.* 12:3967-3975.
- Obana N, Shirahama Y, Abe K, Nakamura K (2010) Stabilization of *Clostridium perfringens* collagenase mRNA by VR-RNA-dependent cleavage in 5' leader sequence. *Mol Microbiol.* 77:1416-1428. doi: 10.1111/j.1365-2958.2010.07258.x. Epub 2010 Jun 23.
- Oh J, Li XH, Kim SK, Lee JH (2017) Post-secretional activation of Protease IV by quorum sensing in *Pseudomonas aeruginosa*. *Sci Rep.* 7:4416. doi: 10.1038/s41598-017-03733-6
- Opdyke JA, Kang JG, Storz G (2004) GadY, a small-RNA regulator of acid response genes in *Escherichia coli*. *J Bacteriol.* 186:6698-6705. doi: 10.1128/JB.186.20.6698-6705.2004
- Ortega AD, Quereda JJ, Pucciarelli MG, García-del Portillo F (2014) Non-coding RNA regulation in pathogenic bacteria located inside eukaryotic cells. *Front Cell Infect Microbiol.* 12:doi: 10.3389/fcimb.2014.00162.
- Padalon-Brauch G, Hershberg R, Elgrably-Weiss M, Baruch K, Rosenshine I, Margalit H, et al. (2008) Small RNAs encoded within genetic islands of *Salmonella typhimurium* show host-induced expression and role in virulence. *Nucleic Acids Res.* 36:1913-1927. doi: 10.1093/nar/gkn050

- Pain A, Ott A, Amine H, Rochat T, Bouloc P, Gautheret D (2015) An assessment of bacterial small RNA target prediction programs. *RNA Biol.* 12:509-513. doi: 10.1080/15476286.2015.1020269.
- Papenfort K, Bassler BL (2016) Quorum sensing signal-response systems in Gram-negative bacteria. *Nat Rev Microbiol.* 14:576-588. doi: 10.1038/nrmicro.2016.89
- Papenfort K, Espinosa E, Casadesus J, Vogel J (2015a) Small RNA-based feedforward loop with AND-gate logic regulates extrachromosomal DNA transfer in Salmonella. *Proc Natl Acad Sci U S A.* 112:E4772-4781. doi: 10.1073/pnas.1507825112
- Papenfort K, Förstner KU, Cong JP, Sharma CM, Bassler BL (2015b) Differential RNA-seq of *Vibrio cholerae* identifies the VqmR small RNA as a regulator of biofilm formation. *Proc Natl Acad Sci U S A.* 112:doi: 10.1073/pnas.1500203112. Epub 2015 Feb 2.
- Papenfort K, Podkaminski D, Hinton JC, Vogel J (2012) The ancestral SgrS RNA discriminates horizontally acquired Salmonella mRNAs through a single G-U wobble pair. *Proc Natl Acad Sci U S A.* 109:doi: 10.1073/pnas.1119414109. Epub 2012 Mar 1.
- Papenfort K, Vanderpool CK (2015) Target activation by regulatory RNAs in bacteria. *FEMS Microbiol Rev.* 39:362-378. doi: fuv016 [pii]10.1093/femsre/fuv016
- Papenfort K, Vogel J (2010) Regulatory RNA in bacterial pathogens. *Cell Host Microbe.* 8:116-127. doi: 10.1016/j.chom.2010.06.008
- Papenfort K, Vogel J (2014) Small RNA functions in carbon metabolism and virulence of enteric pathogens. *Front Cell Infect Microbiol.* 4:91. doi: 10.3389/fcimb.2014.00091
- Park PW, Pier GB, Preston MJ, Goldberger O, Fitzgerald ML, Bernfield M (2000) Syndecan-1 shedding is enhanced by LasA, a secreted virulence factor of *Pseudomonas aeruginosa*. *J Biol Chem.* 275:3057-3064.
- Patenge N, Billion A, Raasch P, Normann J, Wisniewska-Kucper A, Retey J, et al. (2012) Identification of novel growth phase- and media-dependent small non-coding RNAs in *Streptococcus pyogenes* M49 using intergenic tiling arrays. *BMC Genomics.* 13:doi: 10.1186/1471-2164-13-550
- Peer A, Margalit H (2011) Accessibility and evolutionary conservation mark bacterial small-rna target-binding regions. *J Bacteriol.* 193:1690-1701. doi: JB.01419-10 [pii]10.1128/JB.01419-10
- Pernitzsch SR, Sharma CM (2012) Transcriptome complexity and riboregulation in the human pathogen *Helicobacter pylori*. *Front Cell Infect Microbiol.* 2:14. doi: 10.3389/fcimb.2012.00014
- Pernitzsch SR, Tirier SM, Beier D, Sharma CM (2014) A variable homopolymeric G-repeat defines small RNA-mediated posttranscriptional regulation of a chemotaxis receptor in *Helicobacter pylori*. *Proc Natl Acad Sci U S A.* 111:E501-510. doi: 10.1073/pnas.1315152111
- Pessi G, Williams F, Hindle Z, Heurlier K, Holden MT, Cámara M, et al. (2001) The global posttranscriptional regulator RsmA modulates production of virulence determinants and N-

acylhomoserine lactones in *Pseudomonas aeruginosa*. *J Bacteriol.* 183:6676-6683. doi: 10.1128/JB.183.22.6676-6683.2001

Pfeiffer V, Sittka A, Tomer R, Tedin K, Brinkmann V, Vogel J (2007) A small non-coding RNA of the invasion gene island (SPI-1) represses outer membrane protein synthesis from the *Salmonella* core genome. *Mol Microbiol.* 66:1174-1191. doi: 10.1111/j.1365-2958.2007.05991.x

Pinzon NM, Ju LK (2009) Analysis of rhamnolipid biosurfactants by methylene blue complexation. *Appl Microbiol Biotechnol.* 82:975-981. doi: 10.1007/s00253-009-1896-9

Qadri SM, Donkor DA, Bhakta V, Eltringham-Smith LJ, Dwivedi DJ, Moore JC, et al. (2016) Phosphatidylserine externalization and procoagulant activation of erythrocytes induced by *Pseudomonas aeruginosa* virulence factor pyocyanin. *J Cell Mol Med.* 20:710-720. doi: 10.1111/jcmm.12778

Quereda JJ, Ortega AD, Pucciarelli MG, Garcia-Del Portillo F (2014) The *Listeria* Small RNA Rli27 Regulates a Cell Wall Protein inside Eukaryotic Cells by Targeting a Long 5'-UTR Variant. *PLoS Genet.* 10:e1004765. doi: 10.1371/journal.pgen.1004765

Reen FJ, Mooij MJ, Holcombe LJ, McSweeney CM, McGlacken GP, Morrissey JP, et al. (2011) The *Pseudomonas* quinolone signal (PQS), and its precursor HHQ, modulate interspecies and interkingdom behaviour. *FEMS Microbiol Ecol.* 77:413-428. doi: 10.1111/j.1574-6941.2011.01121.x

Reinhart AA, Nguyen AT, Brewer LK, Bevere J, Jones JW, Kane MA, et al. (2017) The *Pseudomonas aeruginosa* PrrF Small RNAs Regulate Iron Homeostasis during Acute Murine Lung Infection. *Infect Immun.* 85:doi: 10.1128/IAI.00764-16

Reinhart AA, Powell DA, Nguyen AT, O'Neill M, Djapgne L, Wilks A, et al. (2015) The prrF-encoded small regulatory RNAs are required for iron homeostasis and virulence of *Pseudomonas aeruginosa*. *Infect Immun.* 83:863-875. doi: 10.1128/IAI.02707-14

Revelles O, Millard P, Nougayrede JP, Dobrindt U, Oswald E, Letisse F, et al. (2013) The carbon storage regulator (Csr) system exerts a nutrient-specific control over central metabolism in *Escherichia coli* strain Nissle 1917. *PLoS One.* 8:e66386. doi: 10.1371/journal.pone.0066386

Richard AL, Withey JH, Beyhan S, Yildiz F, DiRita VJ (2010) The *Vibrio cholerae* virulence regulatory cascade controls glucose uptake through activation of TarA, a small regulatory RNA. *Mol Microbiol.* 78:1171-1181. doi: 10.1111/j.1365-2958.2010.07397.x. Epub 2010 Sep 30

Roberts SA, Scott JR (2007) RivR and the small RNA RivX: the missing links between the CovR regulatory cascade and the Mga regulon. *Mol Microbiol.* 66:1506-1522. doi: 10.1111/j.1365-2958.2007.06015.x

Romby P, Vandenesch F, Wagner EG (2006) The role of RNAs in the regulation of virulence-gene expression. *Curr Opin Microbiol.* 9:229-236. doi: 10.1016/j.mib.2006.02.005

- Romilly C, Lays C, Tomasini A, Caldelari I, Benito Y, Hammann P, et al. (2014) A non-coding RNA promotes bacterial persistence and decreases virulence by regulating a regulator in *Staphylococcus aureus*. *PLoS Pathog.* 10:e1003979. doi: 10.1371/journal.ppat.1003979
- Rutherford ST, Bassler BL (2012) Bacterial quorum sensing: its role in virulence and possibilities for its control. *Cold Spring Harb Perspect Med.* 2:doi: 10.1101/cshperspect.a012427
- Ryall B, Davies JC, Wilson R, Shoemark A, Williams HD (2008) *Pseudomonas aeruginosa*, cyanide accumulation and lung function in CF and non-CF bronchiectasis patients. *Eur Respir J.* 32:740-747. doi: 10.1183/09031936.00159607
- Sadikot RT, Blackwell TS, Christman JW, Prince AS (2005) Pathogen-host interactions in *Pseudomonas aeruginosa* pneumonia. *Am J Respir Crit Care Med.* 171:1209-1223. doi: 10.1164/rccm.200408-1044SO
- Sambrook J, Russell DW (2001). *Molecular cloning - a laboratory manual.* Cold Spring Harbor Laboratory Press, Cold Spring Harbor
- Santiviago CA, Reynolds MM, Porwollik S, Choi SH, Long F, Andrews-Polymenis HL, et al. (2009) Analysis of pools of targeted *Salmonella* deletion mutants identifies novel genes affecting fitness during competitive infection in mice. *PLoS Pathog.* 5:e1000477. doi: 10.1371/journal.ppat.1000477
- Schafhauser J, Lepine F, McKay G, Ahlgren HG, Khakimova M, Nguyen D (2014) The stringent response modulates 4-hydroxy-2-alkylquinoline biosynthesis and quorum-sensing hierarchy in *Pseudomonas aeruginosa*. *J Bacteriol.* 196:1641-1650. doi: 10.1128/JB.01086-13
- Schmidtke C, Abendroth U, Brock J, Serrania J, Becker A, Bonas U (2013) Small RNA sX13: a multifaceted regulator of virulence in the plant pathogen *Xanthomonas*. *PLoS Pathog.* 9:e1003626. doi: 10.1371/journal.ppat.1003626
- Schroeder CL, Narra HP, Rojas M, Sahni A, Patel J, Khanipov K, et al. (2015) Bacterial small RNAs in the Genus *Rickettsia*. *BMC Genomics.* 16:1075. doi: 10.1186/s12864-015-2293-7
- Sedlyarova N, Shamovsky I, Bharati BK, Epshtein V, Chen J, Gottesman S, et al. (2016) sRNA-Mediated Control of Transcription Termination in *E. coli*. *Cell.* 167:doi: 10.1016/j.cell.2016.09.004.
- Serra DO, Mika F, Richter AM, Hengge R (2016) The green tea polyphenol EGCG inhibits *E. coli* biofilm formation by impairing amyloid curli fibre assembly and downregulating the biofilm regulator CsgD via the $\sigma(E)$ -dependent sRNA RybB. *Mol Microbiol.* 101:136-151. doi: 10.1111/mmi.13379. Epub 2016 May 6.
- Shao Y, Bassler BL (2014) Quorum regulatory small RNAs repress type VI secretion in *Vibrio cholerae*. *Mol Microbiol.* 92:921-930. doi: 10.1111/mmi.12599
- Sharma C, M., Vogel J (2009) Experimental approaches for the discovery and characterization of regulatory small RNA. *Curr Opin Microbiol.* 12:536-546. doi: 10.1016/j.mib.2009.07.006

- Shi Y, Tyson GW, DeLong EF (2009) Metatranscriptomics reveals unique microbial small RNAs in the ocean's water column. *Nature*. 459:266-269. doi: 10.1038/nature08055
- Shigematsu T, Fukushima J, Oyama M, Tsuda M, Kawamoto S, Okuda K (2001) Iron-Mediated regulation of alkaline proteinase production in *Pseudomonas aeruginosa*. *Microbiol Immunol*. 45:579-590.
- Sievers S, Sternkopf Lillebaek EM, Jacobsen K, Lund A, Mollerup MS, Nielsen PK, et al. (2014) A multicopy sRNA of *Listeria monocytogenes* regulates expression of the virulence adhesin LapB. *Nucleic Acids Res*. 42:9383-9398. doi: 10.1093/nar/gku630
- Silvaggi JM, Perkins JB, Losick R (2006) Genes for small, noncoding RNAs under sporulation control in *Bacillus subtilis*. *J Bacteriol*. 188:532-541. doi: 10.1128/JB.188.2.532-541.2006
- Sittka A, Lucchini S, Papenfort K, Sharma CM, Rolle K, Binnewies TT, et al. (2008) Deep sequencing analysis of small noncoding RNA and mRNA targets of the global post-transcriptional regulator, Hfq. *PLoS Genet*. 4:doi: 10.1371/journal.pgen.1000163
- Smith L, Rose B, Tingpej P, Zhu H, Conibear T, Manos J, et al. (2006) Protease IV production in *Pseudomonas aeruginosa* from the lungs of adults with cystic fibrosis. *J Med Microbiol*. 55:1641-1644. doi: 10.1099/jmm.0.46845-0
- Soberon-Chavez G, Lepine F, Deziel E (2005) Production of rhamnolipids by *Pseudomonas aeruginosa*. *Appl Microbiol Biotechnol*. 68:718-725. doi: <https://doi.org/10.1007/s00253-005-0150-3>
- Song T, Mika F, Lindmark B, Liu Z, Schild S, Bishop A, et al. (2008) A new *Vibrio cholerae* sRNA modulates colonization and affects release of outer membrane vesicles. *Mol Microbiol*. 70:100-111. doi: 10.1111/j.1365-2958.2008.06392.x
- Sonnleitner E, Abdou L, Haas D (2009) Small RNA as global regulator of carbon catabolite repression in *Pseudomonas aeruginosa*. *Proc Natl Acad Sci U S A*. 106:21866-21871.
- Sonnleitner E, Gonzalez N, Sorger-Domenigg T, Heeb S, Richter AS, Backofen R, et al. (2011) The small RNA PhrS stimulates synthesis of the *Pseudomonas aeruginosa* quinolone signal. *Mol Microbiol*. 80:868-885.
- Sonnleitner E, Sorger-Domenigg T, Madej MJ, Findeiss S, Hackermüller J, Hüttenhofer A, et al. (2008) Detection of small RNAs in *Pseudomonas aeruginosa* by RNomics and structure-based bioinformatic tools. *Microbiology*. 154:3175-3187. doi: 10.1099/mic.0.2008/019703-0
- Soper T, Mandin P, Majdalani N, Gottesman S, Woodson SA (2010) Positive regulation by small RNAs and the role of Hfq. *Proc Natl Acad Sci U S A*. 107:9602-9607. doi: 10.1073/pnas.1004435107
- Sridhar J, Gunasekaran P (2013) Computational small RNA prediction in bacteria. *Bioinform Biol Insights*. 7:83-95. doi: 10.4137/BBIS11213
- Storz G, Altuvia S, Wassarman KM (2005) An abundance of RNA regulators. *Annu Rev Biochem*. 74:199-217. doi: 10.1146/annurev.biochem.74.082803.133136

- Storz G, Haas D (2007) A guide to small RNAs in microorganisms. *Curr Opin Microbiol.* 10:93-95. doi: 10.1016/j.mib.2007.03.017
- Storz G, Opdyke JA, Zhang A (2004) Controlling mRNA stability and translation with small, noncoding RNAs. *Curr Opin Microbiol.* 7:140-144. doi: 10.1016/j.mib.2004.02.015
- Stover CK, Pham XQ, Erwin AL, Mizoguchi SD, Warren P, Hickey MJ, et al. (2000) Complete genome sequence of *Pseudomonas aeruginosa* PAO1, an opportunistic pathogen. *Nature.* 406:959-964. doi: 10.1038/35023079
- Strateva T, Mitov I (2011) Contribution of an arsenal of virulence factors to pathogenesis of *Pseudomonas aeruginosa* infections. *Ann Microbiol.* 61:717-732. doi: 10.1007/s13213-011-0273-y
- Svensson SL, Sharma CM (2016) Small RNAs in Bacterial Virulence and Communication. *Microbiol Spectr.* 4:doi: 10.1128/microbiolspec.VMBF-0028-2015.
- Tafer H, Hofacker IL (2008) RNAplex: a fast tool for RNA-RNA interaction search. *Bioinformatics.* 24:2657-2663. doi: btn193 [pii]10.1093/bioinformatics/btn193
- Tang A, Caballero AR, Marquart ME, O'Callaghan RJ (2013) *Pseudomonas aeruginosa* small protease (PASP), a keratitis virulence factor. *Invest Ophthalmol Vis Sci.* 54:2821-2828. doi: 10.1167/iovs.13-11788
- Ternan NG (2013) Small regulatory RNA molecules in bacteria. *OA Microbiology.* 1:
- Thomason MK, Fontaine F, De Lay N, Storz G (2012) A small RNA that regulates motility and biofilm formation in response to changes in nutrient availability in *Escherichia coli*. *Mol Microbiol.* 84:17-35. doi: 10.1111/j.1365-2958.2012.07965.x
- Tjaden BC (2008) TargetRNA: a tool for predicting targets of small RNA action in bacteria. *Nucleic Acids Res.* 36:doi: 10.1093/nar/gkn264
- Toledo-Arana A, Dussurget O, Nikitas G, Sesto N, Guet-Revillet H, Balestrino D, et al. (2009) The *Listeria* transcriptional landscape from saprophytism to virulence. *Nature.* 459:950-956. doi: 10.1038/nature08080
- Tomizawa J, Itoh T, Selzer G, Som T (1981) Inhibition of ColE1 RNA primer formation by a plasmid-specified small RNA. *Proc Natl Acad Sci U S A.* 78:
- Turner K, Everett J, Trivedi U, Rumbaugh K, Whiteley M (2014) Requirements for *Pseudomonas aeruginosa* acute burn and chronic surgical wound infection. *PLoS Genet.* 10:341-348. doi: 10.1371/journal.pgen.1004518
- van 't Wout EF, van Schadewijk A, van Boxtel R, Dalton LE, Clarke HJ, Tommassen J, et al. (2015) Virulence Factors of *Pseudomonas aeruginosa* Induce Both the Unfolded Protein and Integrated Stress Responses in Airway Epithelial Cells. *PLoS Pathog.* 11:doi: 10.1371/journal.ppat.1004946
- van Delden C, Comte R, Bally AM (2001) Stringent response activates quorum sensing and modulates cell density-dependent gene expression in *Pseudomonas aeruginosa*. *J Bacteriol.* 183:5376-5384. doi: https://doi.org/10.1128/JB.183.18.5376-5384.2001

- van der Meulen SB, de Jong A, Kok J (2017) Early Transcriptome Response of *Lactococcus lactis* to Environmental Stresses Reveals Differentially Expressed Small Regulatory RNAs and tRNAs. *Front Microbiol.* 8:1704. doi: 10.3389/fmicb.2017.01704
- Van Gennip M, Christensen LD, Alhede M, Phipps R, Jensen PO, Christophersen L, et al. (2009) Inactivation of the *rhIA* gene in *Pseudomonas aeruginosa* prevents rhamnolipid production, disabling the protection against polymorphonuclear leukocytes. *APMIS.* 117:537-546. doi: <https://doi.org/10.1111/j.1600-0463.2009.02466.x>
- Vanderpool CK, Balasubramanian D, Lloyd CR (2011) Dual-function RNA regulators in bacteria. *Biochimie.* 93:1943-1949. doi: 10.1016/j.biochi.2011.07.016
- Vinckx T, Wei Q, Matthijs S, Cornelis P (2010) The *Pseudomonas aeruginosa* oxidative stress regulator OxyR influences production of pyocyanin and rhamnolipids: protective role of pyocyanin. *Microbiology.* 156:678-686. doi: 10.1099/mic.0.031971-0
- Vogel J, Sharma C, M. (2005) How to find small non-coding RNAs in bacteria. *Biol Chem.* 386:1219-1238. doi: 10.1515/BC.2005.140
- Vogel J, Wagner EG (2007) Target identification of small noncoding RNAs in bacteria. *Curr Opin Microbiol.* 10:262-270. doi: S1369-5274(07)00061-6 [pii]10.1016/j.mib.2007.06.001
- Wadler CS, Vanderpool CK (2009) Characterization of homologs of the small RNA SgrS reveals diversity in function. *Nucleic Acids Res.* 37:5477-5485. doi: 10.1093/nar/gkp591
- Wagner EGH, Romby P (2015) Small RNAs in bacteria and archaea: who they are, what they do, and how they do it. *Adv Genet.* 90:133-208. doi: 10.1016/bs.adgen.2015.05.001
- Wang J, Rennie W, Liu C, Carmack CS, Prévost K, Caron MP, et al. (2015) Identification of bacterial sRNA regulatory targets using ribosome profiling. *Nucleic Acids Res.* 43:10308-10320. doi: 10.1093/nar/gkv1158
- Wassarman K, M., Repoila F, Rosenow C, Storz G, Gottesman S (2001) Identification of novel small RNAs using comparative genomics and microarrays. *Genes Dev.* 15:1637-1651. doi: 10.1101/gad.901001
- Waters LS, Storz G (2009) Regulatory RNAs in bacteria. *Cell.* 136:615-628. doi: 10.1016/j.cell.2009.01.043
- Wenner N, Maes A, Cotado-Sampayo M, Lapouge K (2014) NrsZ: a novel, processed, nitrogen-dependent, small non-coding RNA that regulates *Pseudomonas aeruginosa* PAO1 virulence. *Environ Microbiol.* 16:1053-1068. doi: 10.1111/1462-2920.12272
- Westermann AJ, Förstner KU, Amman F, Barquist L, Chao Y, Schulte LN, et al. (2016) Dual RNA-seq unveils noncoding RNA functions in host-pathogen interactions. *Nature.* 529:496-501. doi: 10.1038/nature16547
- Wilderman PJ, Sowa NA, FitzGerald DJ, FitzGerald PC, Gottesman S, Ochsner UA, et al. (2004) Identification of tandem duplicate regulatory small RNAs in *Pseudomonas aeruginosa* involved in iron homeostasis. *Proc Natl Acad Sci U S A.* 101:9792-9797.

Wood TL, Gong T, Zhu L, Miller J, Miller DS, Yin B, et al. (2018) Rhamnolipids from *Pseudomonas aeruginosa* disperse the biofilms of sulfate-reducing bacteria. *NPJ Biofilms Microbiomes*. 4:22. doi: 10.1038/s41522-018-0066-1

Wright PR, Georg J, Mann M, Sorescu DA, Richter AS, Lott S, et al. (2014) CopraRNA and IntaRNA: predicting small RNA targets, networks and interaction domains. *Nucleic Acids Res*. 42:doi: 10.1093/nar/gku359

Yanagihara K, Tomono K, Kaneko Y, Miyazaki Y, Tsukamoto K, Hirakata Y, et al. (2003) Role of elastase in a mouse model of chronic respiratory *Pseudomonas aeruginosa* infection that mimics diffuse panbronchiolitis. *J Med Microbiol*. 52:531-535. doi: 10.1099/jmm.0.05154-0

Ying X, Cao Y, Wu J, Liu Q, Cha L, Li W (2011) sTarPicker: a method for efficient prediction of bacterial sRNA targets based on a two-step model for hybridization. *PLoS One*. 6:e22705. doi: 10.1371/journal.pone.0022705 PONE-D-11-01268 [pii]

Zhang YF, Han K, Chandler CE, Tjaden B, Ernst RK, Lory S (2017) Probing the sRNA regulatory landscape of *P. aeruginosa*: post-transcriptional control of determinants of pathogenicity and antibiotic susceptibility. *Mol Microbiol*. 106:919-937. doi: 10.1111/mmi.13857

Zorgani MA, Quentin R, Lartigue MF (2016) Regulatory RNAs in the Less Studied Streptococcal Species: From Nomenclature to Identification. *Front Microbiol*. 7:1161. doi: 10.3389/fmicb.2016.01161

Adam EC, Mitchell BS, Schumacher DU, Grant G, Schumacher U (1997) *Pseudomonas aeruginosa* II lectin stops human ciliary beating: therapeutic implications of fucose. *Am J Respir Crit Care Med*. 155:2102-2104. doi: 10.1164/ajrccm.155.6.9196121