Nicolai Juul Birkbak

Curriculum Vitae
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Personal data:

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Date of birth: February 1st, 1980
Nationality: Danish
Marital status: Married, three children

Note: Name change from N. Juul to
N. Juul Birkbak (2010)

Current workplace:

Associate Professor
Department of Molecular Medicine (MOMA)
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Aarhus University Hospital
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Personal statement

I am an independent group leader, working at the Department of Molecular Medicine, Aarhus University Hospital, and the Department of Clinical Medicine, Aarhus University. My research group was established in 2018, is entirely dry-lab, and has over the years typically included 5-10 members, counting graduate students, PhD students, and post docs. The goal of my research is to understand the how and why of cancer. What drives development of cancer, how does pre-neoplastic cells evolve into invasive cancer and eventually to terminal metastatic disease. Over the past years my lab has focused on exploring the biology of metastatic cancer, and on developing methods to track cancer in vivo using non-invasive technologies such as medical imaging and liquid biopsies. Our work on cancer evolution, supported by that of others, has shown that the metastatic cancer genome is not significantly different from that of primary cancer, indicating that the main driver of cancer metastasis may be found elsewhere. One possible overlooked driver of cancer metastasis may be host (patient) biology. As we age, we suffer from metabolic alterations, loss of epigenetic information, a decline of immune function, and a switch to more aggressive innate immune responses. These alterations correlate with onset of age-related diseases, including cancer. A major focus of my lab today is understanding how changing host biology may drive the development of primary into metastatic cancer. We do this through analysis of single cell and spatial transcriptomic data, through bulk RNAseq analysis of cancer and non-cancer tissue, and through analysis of medical imaging scans to assess the health of immune organs in vivo. If we can identify specific elements that may combine to create a cancer-promoting environment in the body, it may be possible to develop screening tools for early detection, and potentially drugs that may reduce the chance of undetected primary cancers developing into metastatic disease.

Academic achievements

Ph. D., Technical University of Denmark, Denmark **2007-2010**
Degree: Ph.D. in Bioinformatics, date: December 21st 2010.
Title: Identification of breast cancer biomarkers for personalized medicine.
Supervisor: Zoltan Szallasi (zszallasi@chip.org)
Committee members: Søren Brunak, Carlos Caldas, Jiri Bartek.

Master of Science, University of Aarhus, Denmark **2003-2007**
Degree: MSc in Molecular Biology, date: February 5th 2007.
Title: Analysis of *Chlamydia* when cultured at *in vivo* oxygen concentration & Investigation of the effects of differential expression of *Chlamydia pneumoniae* polymorphic membrane protein Pmp10.
Supervisor: Svend Birkelund

Bachelor of Science, University of Aarhus, Denmark **2000-2003**
Degree: BSc in Biotechnology, date: October 2nd 2003.
Title: Analysis of beta globulins

Professional experience

Professor, principal investigator (2024-present)
Aarhus University, Aarhus, Denmark
Independent group leader, performing bioinformatic-based analysis of cancer sequence and other multi-omics data. The primary scientific focus of the group is cancer evolution and immunology, understanding how cancer develops from normal cells, how it acquires the ability to metastasize and how it interacts with the immune system. We have a strong focus on dissecting host-related factors that may contribute to cancer development and progression and dissecting the host response to cancer through all stages. Our work includes analysis of cancer genomic evolution, assessment of local and systemic immune responses, and tumor-host interactions, particularly exploring how a diminished immune response may lead to reduced capacity to resist metastatic dissemination.

Associate professor, principal investigator (2018-2024)
Aarhus University, Aarhus, Denmark
Established as independent group leader, performing bioinformatic-based analysis of cancer sequence and other multi-omics data. The primary scientific focus of the group is cancer evolution, understanding how cancer develops from normal cells, how it acquires the ability to metastasize.

Principal research associate, Swanton lab, (Charles.Swanton@crick.ac.uk)
University College London, London, United Kingdom (2014-2018)
Provides part of the bioinformatics backbone for translational analysis of the TRACERx project, a massive undertaking in cancer genetics lead by Professor Charles Swanton. The TRACERx project is a clinical trial in non-small cell lung cancer that studies the extent of intratumor heterogeneity and the impact of ITH on cancer progression, recurrence and response to treatment. As part of this project, we are whole exome sequencing tumors from 842 patients, using a multi-region approach. In total, we will collect between 5000 and 6000 exomes over 5 years. These are put through our bioinformatics pipeline for pre-processing and subsequent analysis. We also collect and characterize RNA for RNAseq, ctDNA for analysis of variants in plasma, and CT-scans for radiomics profiling. As patients relapse or die, we collect and sequence metastatic and/or post-mortem specimens to

further investigate which cancer subclone may have caused metastatic disease, and assess the role of intratumor heterogeneity in cancer progression and treatment resistance. Patients that relapse are offered molecularly targeted therapy if applicable through associated clinical trials.

Post doc, Szallasi lab, (zszallasi@chip.org)
Technical University of Denmark, Lyngby, Denmark (2012-2014)
Bioinformatics and translational research in a university setting. Significant grant writing and teaching responsibilities, that in particular includes supervising graduate and PhD students and junior post docs. Research includes primary research and participation in large international collaborations where I provide bioinformatics input in projects that spans across many types of cancer with collaborators in the UK, US, and Canada. In addition I provide expert input on analyzing cancer samples using high-throughput technologies to discover novel associations between tumor characteristics and chemotherapy sensitivity.

Post doc, Richardson lab (aricha58@jhmi.edu)
Dana-Farber Cancer Institute, Boston, USA (2010-2012)
Bioinformatics, translational research, analyzing breast and ovarian tumor samples using high-throughput technologies to discover novel associations between tumor characteristics and chemotherapy sensitivity. Integrated collaboration with oncologists, pathologists and cancer biologists for optimal bench-to-bedside research. Responsibilities included driving own projects from a bioinformatics angle, and providing expert bioinformatics input on all projects in the lab, including in particular advising graduate students.

Ph. D. student, Szallasi lab (zszallasi@chip.org)
Technical University of Denmark, Lyngby, Denmark (2007-2010)
Bioinformatics, research based on high-throughput technologies pulled from public repositories and through collaborations to discover new phenotypes of breast cancer that are associated with cancer-specific survival and sensitivity to chemotherapy.

Graduate student, Birkelund lab
Aarhus University, Aarhus, Denmark (2004-2007)
Cell work, basic research focused on the obligate intracellular bacteria Chlamydia. Developed methods to culture Chlamydia bacteria at physiological oxygen levels and analyzed the growth by qPCR and protein content by mass spectrometry.

Grants and awards

2023 Novo Nordic Foundation, 10.1 million DKK
2021 Novo Nordic Foundation, 3 million DKK
2020 Jens Chr Skou Award 2020, 100,000 DKK
2019 Danish Cancer Society Junior Researcher of the Year, 100,000 DKK
2018 Aarhus University Research Foundation, 3.25 million DKK
2018 Lundbeckfonden fellow, 10 million DKK
2017 Crick Translational Research Fellow 2017
2017 CRUK translational Cancer Research prize (TRACERx team award, 27 investigators), £25,000
2014 Researcher of the year award, Technical University of Denmark, 10,000DKK
2013 Travel grant to attend the IMPAKT breast cancer conference in Bruxelles, May 1st-4th, 2013. The Danish Cancer Society, 7,742 DKK.

2012 Post doc grant, The Villum Kann Rasmussen Foundation, 2 years salary.
2011 Best poster award, XX Porto Cancer Meeting. Porto, Portugal, April 2011.
2011 Best presentation, Dana-Farber Harvard Cancer Center breast and gynecologic cancer symposium, Boston, March 2011, $500.
2010 Post doc grant, Danish Research Council, 2 year period, total 2,111,305 DKK.
2007 Ph. D. fellowship, Technical University of Denmark, 3 years.
2006 Travel grant, to attend the Eleventh International Symposium on Human Chlamydial Infection, 10,000 DKK.

Talks and conference contributions (selected)

Invited talk. Conference on Personalised Medicine, Aarhus, October 25th 2023.
Invited talk. Biomarkers in cancer immunotherapy, Copenhagen, June 20th 2022.
Invited talk. International Bladder Cancer Network, Aarhus, October 4th 2019.
Invited talk. CRUK Lung Cancer Centre of Excellence conference, Manchester, December 3-5th 2017.
Poster Presentation. CRUK Lung Cancer Centre of Excellence conference, Manchester, December 3-5th 2017.
Invited talk. Francis Crick Institute, Cancer seminar series, May 3rd 2017.
Invited talk. EORTC-NCI-AACR 2016 Symposium, Munich, November 29th-December 2nd 2016.
Invited talk. Danish Society of Molecular Medicine, Aarhus, May 25th 2016.
Poster Presentation. CRUK Lung Cancer Centre of Excellence conference, Manchester, December 13-15th 2015.
Invited talk. Association for Cancer Physicians, Precision Oncology workshop, Manchester, October 16th 2015.
Poster Presentation. British Association for Cancer Research, Evolution and Intratumoural Heterogeneity Meeting, London, June 11th 2015.
Invited talk. Danish Center for Translational Breast Cancer Research annual meeting, Copenhagen, January 16th 2014.
Invited talk. NetSci conference, Copenhagen, June 3-7th 2013.
Poster presentation. 5th IMPACT breast cancer conference. Brussels, Belgium, May 2013.
Poster presentation. PTMs in cell signaling. Copenhagen, Denmark, December 2012.
Oral presentation. Genome Instability and Cancer Drug Resistance Conference. Oxon Hoath, UK, June 2012.
Oral presentation. American Association for Cancer Research Annual Meeting. Chicago, IL, USA, April 2012.
Poster presentation. XX Porto Cancer Meeting. Porto, Portugal, April 2011.
Oral presentation. Dana-Farber Harvard Cancer Center breast and gynecologic cancer symposium, Boston, March 2011.
Poster presentation. 2nd IMPACT breast cancer conference. Brussels, Belgium, May 2010.
Poster presentation. San Antonio Breast Cancer Conference. San Antonio, Tx, USA, December 2009.
Oral presentation. Eleventh International Symposium on Human Chlamydial Infections. Niagara-on-the-Lake, June 18th-23rd 2006.

Commissions of trust

2021-2024 Member of the National Genome Center (NGC) Tools and Workflows expert panel

2022- Member of steering committee, Translational Cancer Network, Aarhus University
2022- Member of Biomedical research, Translational research and precision medicine grant review committee for research funding, Helse Sør-Øst, Norway
2008- Ad hoc reviewer for funders and research journals

Supervisor and teaching experience

I currently supervise 3 postdocs, 4 PhD students (as main supervisor), 5 MSc students. I also supervise 3 PhD students as co-supervisor. I have graduated 3 PhD students as main supervisor, and 3 as co-supervisor.

Teaching:
Responsible bachelor projects for medical students at Institute of Clinical Medicine (2021-).
Teaches at "Personalised Medicine" course for medical student (2021-).
Teaches at "The Biology and characteristic of circulating cell free DNA and circulating tumour DNA in health and disease", PhD course (2021-)
Introduction to R and Bioconductor, Harvard School of Public Health, May 2012.
DNA microarray analysis, Technical University of Denmark, January, 2008-2010.
Biological Sequence Analysis, Technical University of Denmark, April 2009.

Reviewer experience

I regularly review for Annals of Oncology, Nature Communications, Nature Genetics, Cell Reports, Cancer Research, Gastroenterology, Clinical Cancer Research, Molecular Oncology and more

International relations

Part of the UK-based TRACERx consortium, close personal collaborations with principal investigators at the Francis Crick Institute (London, UK), Harvard Medical School (Boston, USA), Princess Margaret (Toronto, Canada), Johns Hopkins (Baltimore, USA), and Technical University of Denmark (Lyngby, Denmark). Member of American Association for Cancer Research.

Publications

H-index, April 9th 2025: 63; 30,220 citations (Google Scholar)
https://scholar.google.co.uk/citations?user=S8oPM74AAAAJ&hl=en
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Scientific performance from 2015-2020 (SciVal, Scopus): 51 publications in peer-reviewed journals of which 92% are among the top 10% most cited publications worldwide. The publications are cited 90 times on average. Based on this, my field-weighted citation impact (FWCI) is 10.7, indicating that my publications are cited more than 10 times the world average.

Number of reviewed articles = 95
Book chapters: 1
Editorials: 7
Total citations (Google Scholar) = 30,220
H-index (Google Scholar) = 63

Total number of publications & patents: 108
Number of peer-reviewed publications: 95
First and co-first publications: 14
Last and co-last publications: 13

My publication list includes several high-impact publications, including: 1 co-first author New England Journal of Medicine (impact factor, IF, 176), 1 co-first, 1 co-last & 9 co-author in Nature (IF: 70), 1 co-first, 1 co-last & 2 co-author in Nature Medicine (IF: 87), 1 first- & 1 co-author in Cancer Cell (IF: 39), 1 first, 1 co-first & 1 co-author in Cancer Discovery (IF: 38), 3 co-author in Cell (IF: 42), 1 co-author in CA: A Cancer Journal for Clinicians (IF: 509).

(Co-)First author

1. **Birkbak NJ** and McGranahan N (2020) Cancer Genome Evolutionary Trajectories in Metastasis. Cancer Cell 2020 - Review. PMID 31935374
2. Biswas D,* **Birkbak NJ***$, Rosenthal R, Hiley CT, Lim EL, Papp K, Boeing S, Krzystanek M, Djureinovic D, La Fleur L, Greco M, Döme B, Fillinger J, Brunnström H, Wu Y, Moore DA, Skrzypski M, Abbosh C, Litchfield K, Al Bakir M, Watkins TBK, Veeriah S, Wilson GA, Jamal-Hanjani M, Moldvay J, Botling J, Chinnaiyan AM, Micke P, Hackshaw A, Bartek J, Csabai I, Szallasi Z, Herrero J, McGranahan N$, Swanton C$; TRACERx Consortium (2019) A clonal expression biomarker associates with lung cancer mortality. Nature Medicine 2019 Oct;25(10):1540-1548. doi: 10.1038/s41591-019-0595-z. PMID: 31591602
3. **Birkbak NJ**$, Li Y$, Pathania S$, Greene-Colozzi A, Dreze M, Bowman-Colin C, Sztupinszki Z, Krzystanek M, Diossy M, Tung N, Ryan PD, Garber JE, Silver DP, Iglehart JD, Wang ZC, Szuts D, Szallasi Z, Richardson AL (2018) Overexpression of BLM promotes DNA damage and increased sensitivity to platinum salts in triple negative breast and serous ovarian cancers. Ann Oncol. 2018 Feb 14. doi: 10.1093/annonc/mdy049.PMID: 29452344
4. Abbosh C*, **Birkbak NJ***, Wilson GA*, Jamal-Hanjani M*, Constantin T*, Salari R*, Le Quesne J*, Moore DA, Veeriah S, Rosenthal R, Marafioti T, Kirkizlar E, Watkins TBK, McGranahan N, Ward S, Martinson L, Riley J, Fraioli F, Al Bakir M, Grönroos

E, Zambrana F, Endozo R, Bi WL, Fennessy FM, Sponer N, Johnson D, Laycock J, Shafi S, Czyzewska-Khan J, Rowan A, Chambers T, Matthews N, Turajlic S, Hiley C, Lee SM, Forster MD, Ahmad T, Falzon M, Borg E, Lawrence D, Hayward M, Kolvekar S, Panagiotopoulos N, Janes SM, Thakrar R, Ahmed A, Blackhall F, Summers Y, Hafez D, Naik A, Ganguly A, Kareht S, Shah R, Joseph L, Marie Quinn A, Crosbie PA, Naidu B, Middleton G, Langman G, Trotter S, Nicolson M, Remmen H, Kerr K, Chetty M, Gomersall L, Fennell DA, Nakas A, Rathinam S, Anand G, Khan S, Russell P, Ezhil V, Ismail B, Irvin-Sellers M, Prakash V, Lester JF, Kornaszewska M, Attanoos R, Adams H, Davies H, Oukrif D, Akarca AU, Hartley JA, Lowe HL, Lock S, Iles N, Bell H, Ngai Y, Elgar G, Szallasi Z, Schwarz RF, Herrero J, Stewart A, Quezada SA, Peggs KS, Van Loo P, Dive C, Lin CJ, Rabinowitz M, Aerts HJWL, Hackshaw A, Shaw JA, Zimmermann BG; TRACERx consortium; PEACE consortium, Swanton C (2017) Phylogenetic ctDNA analysis depicts early-stage lung cancer evolution. Nature. 2017 Apr 26;545(7655):446-451. doi: 10.1038/nature22364. PMID: 28445469

5. Jamal-Hanjani M*, Wilson GA*, McGranahan N*, **Birkbak NJ***, Watkins TBK*, Veeriah S*, Shafi S, Johnson DH, Mitter R, Rosenthal R, Salm M, Horswell S, Escudero M, Matthews N, Rowan A, Chambers T, Moore DA, Turajlic S, Xu H, Lee SM, Forster MD, Ahmad T, Hiley CT, Abbosh C, Falzon M, Borg E, Marafioti T, Lawrence D, Hayward M, Kolvekar S, Panagiotopoulos N, Janes SM, Thakrar R, Ahmed A, Blackhall F, Summers Y, Shah R, Joseph L, Quinn AM, Crosbie PA, Naidu B, Middleton G, Langman G, Trotter S, Nicolson M, Remmen H, Kerr K, Chetty M, Gomersall L, Fennell DA, Nakas A, Rathinam S, Anand G, Khan S, Russell P, Ezhil V, Ismail B, Irvin-Sellers M, Prakash V, Lester JF, Kornaszewska M, Attanoos R, Adams H, Davies H, Dentro S, Taniere P, O'Sullivan B, Lowe HL, Hartley JA, Iles N, Bell H, Ngai Y, Shaw JA, Herrero J, Szallasi Z, Schwarz RF, Stewart A, Quezada SA, Le Quesne J, Van Loo P, Dive C, Hackshaw A, Swanton C; TRACERx Consortium (2017) Tracking the Evolution of Non-Small-Cell Lung Cancer. N Engl J Med. 2017 Jun 1;376(22):2109-2121. doi: 10.1056/NEJMoa1616288. Epub 2017 Apr 26. PMID: 28445112
6. Murugaesu N*, Wilson GA*, **Birkbak NJ***, Watkins TBK*, McGranahan N*, Kumar S, Abbassi-Ghadi N, Salm M, Mitter R, Horswell S, Rowan A, Hochhauser D, Hanna GB, Swanton C (2015) Tracking the genomic evolution of esophageal adenocarcinoma through neoadjuvant chemotherapy. Cancer Discov. 2015 Aug;5(8):821-31. doi: 10.1158/2159-8290.CD-15-0412. Epub 2015 May 23. PMID: 26003801 *contributed equally
7. Favero F*, McGranahan N*, Salm M*, **Birkbak NJ***, Sanborn JZ, Benz SC, Becq J, Peden JF, Kingsbury Z, Grocok RJ, Humphray S, Bentley D, Spencer-Dene B, Gutteridge A, Brada M, Roger S, Dietrich PY, Forshew T, Gerlinger M, Rowan A, Stamp G, Eklund AC, Szallasi Z, Swanton C (2015) Glioblastoma adaptation traced through decline of an IDH1 clonal driver and macro-evolution of a double-minute chromosome. Ann Oncol. 2015 Mar 2. pii: mdv127. [Epub ahead of print] PMID: 25732040 *contributed equally
8. **Birkbak NJ**, Kochupurakkal B, Izarzugaza JMG, Eklund AC, Li Y, Liu J, Szallasi Z, Matulonis UA, Richardson AL, Iglehart JD, Wang ZC (2013) Tumor mutation burden forecasts outcome in ovarian cancer with BRCA1 or BRCA2 mutations. PLoS One. 2013 Nov 12;8(11):e80023. doi: 10.1371/journal.pone.0080023.
9. Martinez P*, **Birkbak NJ***, Gerlinger M*, McGranahan N, Burrell R, Rowan A, Joshi T, Fisher R, Larkin J, Szallasi Z, Swanton C (2013) Parallel evolution of tumor

subclones mimics diversity between tumors. J Pathol. 2013 Aug;230(4):356-64. doi: 10.1002/path.4214. *contributed equally

10. **Birkbak NJ,** Wang ZC, Kim JY, Eklund AC, Li Q, Tian R, Bowman-Colin C, Li Y, Greene-Colozzi A, Iglehart JD, Tung N, Ryan PD, Garber JE, Silver DP, Szallasi Z, Richardson AL (2012) Telomeric Allelic Imbalance Indicates Defective DNA Repair and Sensitivity to DNA-Damaging Agents. Cancer Discov. 2012 Apr;2(4):366-75. Epub 2012 Mar 22.
11. **Birkbak NJ**, Eklund AC, Li Q, McClelland SE, Endesfelder D, Tan P, Tan IB, Richardson AL, Szallasi Z, Swanton C (2011) Paradoxical relationship between chromosomal instability and survival outcome in cancer. Cancer Res. 2011 May 15;71(10):3447-52. Epub 2011 Jan 26.
12. **Juul N**, Szallasi Z, Eklund AC, Li Q, Burrell RA, Gerlinger M, Valero V, Andreopoulou E, Esteva FJ, Symmans WF, Desmedt C, Haibe-Kains B, Sotiriou C, Pusztai L, Swanton C (2010) Assessment of an RNA interference screen-derived mitotic and ceramide pathway metagene as a predictor of response to neoadjuvant paclitaxel for primary triple-negative breast cancer: a retrospective analysis of five clinical trials. Lancet Oncol. 2010 Apr;11(4):358-65.
13. **Juul N**, Gevaert K, Timmermann E, Christiansen G, Birkelund S. (2007) Proteolytic cleavage of the Chlamydia pneumoniae Major Outer Membrane Protein in the absence of Pmp10. *Proteomics*. Dec;7(24):4477-87.
14. **Juul N**, Jensen H, Hvid M, Christiansen G, Birkelund S. (2007) Characterization of *in vitro* chlamydial cultures in low oxygen atmospheres. *Journal of Bacteriology*. Sep;189(18):6723-6.

(Co)Last author

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16. Ahrenfeldt J, Carstensen S, Eriksen IMH, **Birkbak NJ**. (2024) Exploring the impact of body mass index on tumor biology and cancer development. J Cancer Res Clin Oncol. 2024 Jul 27;150(7):372. doi: 10.1007/s00432-024-05890-4. PMID: 39068253
17. Andersen L, Kisistók J, Henriksen TV, Bramsen JB, Reinert T, Øgaard N, Mattesen TB, **Birkbak NJ$**, Andersen CL$ (2024) Exploring the biology of ctDNA release in colorectal cancer. Eur J Cancer. 2024 Aug;207:114186. doi: 10.1016/j.ejca.2024.114186. Epub 2024 Jun 26. PMID: 38943900
18. Andersen L, Christensen DS, Kjær A, Knudsen M, Andersen AK, Laursen MB, Ahrenfeldt J, Laursen BE, **Birkbak NJ** (2024) Exploring the molecular landscape of cancer of unknown primary: A comparative analysis with other metastatic cancers. Molecular Oncology. 2024 May 15. doi: 10.1002/1878-0261.13664. PMID: 38750007
19. Sokač M, Kjær A, Dyrskjøt L, Haibe-Kains B, Aerts HJWL, **Birkbak NJ** (2023) Spatial transformation of multi-omics data unlocks novel insights into cancer

biology. eLife. 2023. Sep 5:12:RP87133. doi: 10.7554/eLife.87133. PMID37669321
20. Kisistók J; Christensen, DS; Rasmussen MH; Duval L; Aggerholm-Pedersen N; Luczak AA; Sorensen BS; Jakobsen MR; Oellegaard TH; **Birkbak NJ** (2023) Analysis of circulating tumor DNA during checkpoint inhibition in metastatic melanoma using a tumor-agnostic panel. Melanoma Research. June 05, 2023. DOI: 10.1097/CMR.0000000000000903
21. Abbosh C, Frankell AM, Harrison T, Kisistok J, Garnett A, Johnson L, Veeriah S, Moreau M, Chesh A, Chaunzwa TL, Weiss J, Schroeder MR, Ward S, Grigoriadis K, Shahpurwalla A, Litchfield K, Puttick C, Biswas D, Karasaki T, Black JRM, Martínez-Ruiz C, Bakir MA, Pich O, Watkins TBK, Lim EL, Huebner A, Moore DA, Godin-Heymann N, L'Hernault A, Bye H, Odell A, Roberts P, Gomes F, Patel AJ, Manzano E, Hiley CT, Carey N, Riley J, Cook DE, Hodgson D, Stetson D, Barrett JC, Kortlever RM, Evan GI, Hackshaw A, Daber RD, Shaw JA, Aerts HJWL, Licon A, Stahl J, Jamal-Hanjani M; TRACERx Consortium; **Birkbak NJ**$, McGranahan N, Swanton C. (2023) Tracking early lung cancer metastatic dissemination in TRACERx using ctDNA. Nature. 2023 Apr;616(7957):553-562. doi: 10.1038/s41586-023-05776-4. PMID: 37055640
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23. Ahrenfeldt J, Christensen DS, Østergaard AB, Kisistók J, Sokač M, **Birkbak NJ** (2023) The ratio of adaptive to innate immune cells differs between genders and associates with improved prognosis and response to immunotherapy. PLoS One. 2023 Feb 6;18(2):e0281375. doi: 10.1371/journal.pone.0281375. eCollection 2023. PMID: 36745657
24. Ahrenfeldt J, Christensen DS, Sokač M, Kisistók J, McGranahan N, **Birkbak NJ.** (2022) Computational Analysis Reveals the Temporal Acquisition of Pathway Alterations during the Evolution of Cancer. Cancers (Basel). 2022 Nov 25;14(23):5817. doi: 10.3390/cancers14235817. PMID: 36497297
25. Christensen DS, Ahrenfeldt J, Sokač M, Kisistók J, Thomsen MK, Maretty L, McGranahan N, **Birkbak NJ**. (2022) Treatment Represents a Key Driver of Metastatic Cancer Evolution. Cancer Res. 2022 Aug 16;82(16):2918-2927. doi:10.1158/0008-5472.CAN-22-0562. PMID: 35731928
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27. Marquard AM*, Eklund AC*, Joshi T, Krzystanek M, Favero F, Wang ZC, Richardson AL, Silver DP, Szallasi Z, **Birkbak NJ** (2015) Pan-cancer analysis of genomic scar signatures associated with homologous recombination

deficiency suggests novel indications for existing cancer drugs. Biomark Res. 2015 May 1;3:9. doi: 10.1186/s40364-015-0033-4. eCollection 2015. PMID: 6015868

Contributing author

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