

# Edward C. Holmes

## *Curriculum Vitae*

### Personal Information

- Full Name: Edward Charles Holmes
- Date of Birth: 26<sup>th</sup> February 1965
- Nationality: Dual British and Australian citizen

### Address

Marie Bashir Institute for Infectious Diseases and Biosecurity,  
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  - <http://sydney.edu.au/medicine/people/academics/profiles/edward.holmes.php>
  - <http://sydney.edu.au/charles-perkins-centre/our-research/research-groups/pathogen-discovery-diversity-and-evolution.html>
  - [https://en.wikipedia.org/wiki/Edward\\_C.\\_Holmes](https://en.wikipedia.org/wiki/Edward_C._Holmes)
  - <http://sydney.edu.au/science/biology/viralevolution/index.shtml>
  - <https://scholar.google.com.au/citations?user=Syrp1IMAAAAJ&hl=en>

### Current Appointments

- 2018-Present: ARC Australian Laureate Fellow and Professor, The University of Sydney, Australia.
- 2019-Present: Honorary Visiting Professor, Fudan University, Shanghai, China.
- 2015-Present: Adjunct Member, The Westmead Institute for Medical Research, Sydney, Australia.
- 2014-Present: Guest Professor, Chinese Center for Disease Control and Prevention, Beijing, China.
- 2009-Present: Member, The Center for Infection and Immunity, Columbia University, New York, NY, USA.

### Previous Appointments

- 2012-2017: NHMRC Australia Fellow and Professor, The University of Sydney, Australia.
- 2012: Verne M. Willaman Chair in the Life Sciences, The Pennsylvania State University, University Park, PA, USA.
- 2007-2012: Eberly College of Science Distinguished Senior Scholar, The Pennsylvania State University, University Park, PA, USA.
- 2006-2013: Affiliate member, Fogarty International Center, National Institutes of Health, Bethesda, MD, USA.
- 2005-2012: (Full) Professor of Biology, The Pennsylvania State University, University Park, PA, USA.
- 1999-2004: University Lecturer in Evolutionary Biology, University of Oxford, UK.
- 1999-2004: Tutorial Fellow in Biological Sciences, New College, Oxford, UK.
- 1994-2002: Royal Society University Research Fellow, University of Oxford, UK.
- 1994-1998: Fellow by Special Election of St. Catherine's College, Oxford, UK.

- 1994-1997: Wellcome Trust Fellow in Biodiversity Research, University of Oxford, UK.
- 1993-1994: Postdoctoral research (SERC funded) with Prof. PH Harvey, FRS, Department of Zoology, University of Oxford, UK.
- 1991-1993: Postdoctoral research (MRC funded) with Dr. AJ Leigh Brown, Institute of Cell, Animal and Population Biology, University of Edinburgh, UK.
- 1990-1991: Postdoctoral research with Dr. CH Langley, Department of Genetics, University of California, Davis, USA.

### Qualifications

- 1990: *Ph.D.*, Department of Zoology, University of Cambridge, UK; Thesis entitled '*Pattern and Process in the Molecular Evolution of the Order Primates*'. Supervisor: Dr. AE Friday.
- 1986: *B.Sc.* in Anthropology, University of London (University College), UK. First Class Honours.

### Awards and Honours

- 2017: Fellow, The Royal Society (FRS).
- 2017: Australian Laureate Fellow, Australian Research Council (ARC).
- 2017: NSW Premier's Prize for Science and Engineering (Biological Sciences).
- 2017: Fellow, The Royal Society of New South Wales.
- 2015: Fellow, Australian Academy of Science (FAA).
- 2011: Australia Fellow, National Health and Medical Research Council (NHMRC).
- 2010: Fogarty International Center Director's Merit Award to the Multinational Influenza Seasonal Mortality Study Team (MISMS). National Institutes of Health, USA.
- 2010: Faculty Scholars Medal in the Life and Health Sciences. The Pennsylvania State University, USA.
- 2008: Kavli Fellow, National Academy of Sciences, USA.
- 2003: Scientific Medal. Zoological Society of London, UK.

### Seminars (Selected; Invited Speaker, Keynote Speaker, Plenary Lecturer), 2014-2019

- 2019: Eighty years of the Archives of Virology. Vienna, Austria.
- 2019: Society for Molecular Biology and Evolution. Manchester, UK.
- 2019: Symposium on View to the Future for Public Health and Personalised Infectious Disease Care. Melbourne, Australia.
- 2019: 2nd Symposium Geneva Centre for Emerging Viral Diseases. Geneva, Switzerland.
- 2019: International Conference on Influenza and Other Infections. Tokyo, Japan.
- 2018: XXIV Congress of the Latin American Association of Microbiology. Santiago, Chile.
- 2018. Skerman Lecture, University of Queensland, Australia.
- 2018: Institut Pasteur conference on Emerging Infections and Pandemic Risk. Institut Pasteur, Paris, France.
- 2018. Influenza 2018: Centenary of the 1918 Pandemic. Francis Crick Institute, London, UK.
- 2018: ASM Microbe, American Society for Microbiology. Atlanta, USA.
- 2018: ASID Annual Scientific Meeting 2018. Gold Coast, Australia.
- 2017: 3<sup>rd</sup> One Health Aotearoa Symposium. Wellington, New Zealand.
- 2017: 12<sup>th</sup> International Congress on Genomics. Shenzhen, China.
- 2017: 2017 Australian Tropical Health Conference. Cairns, Australia.
- 2017: International Union of Microbiological Societies. Singapore.
- 2016: 4<sup>th</sup> International One Health Congress. Melbourne, Australia.
- 2016: 16th Asia Pacific Congress of Clinical Microbiology and Infection. Melbourne, Australia.
- 2016: 12th Mosquito Control Association of Australia and 9th Arbovirus Research in Australia. Gold Coast, Australia.
- 2016: Wellcome Trust Scientific Conference on Virus Genomics and Evolution. Wellcome Genome Campus, Hinxton, UK.

- 2015: 8<sup>th</sup> Australian Virology Society Meeting. Hunter Valley, Australia.
- 2015: 10<sup>th</sup> International Conference on Bioinformatics: Genomics and Evolution of Pathogens and Hosts. Atlanta, Georgia, USA.
- 2015: 20th International Bioinformatics Workshop on Virus Evolution and Molecular Epidemiology. Trinidad and Tobago.
- 2015: Australian Society for Microbiology 2015. Canberra, Australia.
- 2015: 3<sup>rd</sup> International One Health Congress. Amsterdam, The Netherlands.
- 2014: 12<sup>th</sup> International Conference on Molecular Epidemiology and Evolutionary Genetics of Infectious Diseases. Bangkok, Thailand.
- 2014: Australian Institute of Medical Scientists. National Scientific Meeting, Sydney, Australia.
- 2014: Multinational Influenza Seasonal Mortality Study conference. NIH, Bethesda, Maryland, USA.
- 2014: Lorne Infection & Immunity Conference, 2014. Lorne, Australia.
- 2014: Symposium on Influenza Transmission and Control. Hong Kong.

### Teaching and Mentoring

- 2009: Taught module on 'Evolutionary Inference and Infectious Disease Phylodynamics' as part of the 'Summer Institutes in Statistics and Modelling in Infectious Diseases', University of Washington, Seattle.
- 2007, 2009, 2011: Contributed lectures on viral evolution to 'The Rockefeller University Virology Course'. The Rockefeller University, New York.
- 2005-2012: Course organiser – 'The Evolution of Infectious Disease' at The Pennsylvania State University.
- 1994-2004: Lecturer, and eventually course organiser – 'Evolution & Systematics', University of Oxford.
- 1999-2004: Tutorial Fellow in Biological Sciences, New College, Oxford. Tuition in many aspects of biological science, most notably evolutionary biology and infectious disease biology.
- 1994-Present: Supervision of 31 graduate students (BBSRC, NSERC, Rhodes Trust, Wellcome Trust, NIH, NSF, NHMRC, ARC, APA and start-up grant funded).
- 1989-Present: Lecturing, particularly in evolutionary biology, population genetics, the ecology and evolution of infectious disease and virology, to undergraduate, masters and postgraduate students at the universities of Cambridge, California (Davis), Edinburgh, Oxford, Penn State and Sydney.

### Professional Service

- Editor, *Oxford Bibliographies in Evolutionary Biology* (2012-2014).
- Editor, *Epidemics* (2007-2008).
- Associate Editor and Section Editor, *PLoS Pathogens* (2006-2009).
- Associate Editor, *Molecular Biology & Evolution* (2000-2009).
- Editorial Board, *Cell Host & Microbe* (2020-present).
- Editorial Board, *One Health* (2015-2017).
- Editorial Board, *Philosophical Transactions of the Royal Society Series B* (2013-2019).
- Editorial Board (and founding member), *Annual Reviews of Virology* (2012-2013).
- Editorial Board, *Evolutionary Medicine and Public Health* (2012-2014).
- Editorial Board, *Current Opinion in Virology* (2010-present).
- Editorial Board, *Journal of Virology* (2007-present).
- Editorial Board, *Virology* (2006-present).
- Editorial Board, *Journal of General Virology* (1997-2002; 2007-2012).
- Editorial Board, *Journal of Evolutionary Biology* (1995-2000).
- Honorary Editor, *Evolutionary Bioinformatics* (2005-2008).
- Chief Moderator (and co-founder), *PLoS Currents: Influenza* (2009-2012).
- Member, *American Society for Microbiology* (2005-present).

- Member, International Consultant Committee for Global Public Health (ICCGPH), China CDC, Beijing.
- Member, Global Virus Network (GVN).
- Member, Scientific Advisory Board, 'Area of Excellence on the Control of Pandemic an Inter-Pandemic Influenza'. University of Hong Kong (2008).
- Member, Advisory Council, Department of Ecology & Evolution, Princeton University (2011).
- Member, *Faculty of 1000 Biology* (2006-2008; resigned).
- Member of Royal Society working group on the safety of GM plants for food use (2001).
- Organizing Committee, 'Options for the Control of Influenza' conference (meetings VII and VIII).
- Scientific Advisory Committee, NHMRC CRE in Infectious Diseases Modelling to Inform Policy (2015-present).
- Steering Committee, Ramaciotti Centre for Genomics (2013-2019).
- Chair, NSW Public Health Pathogen Genomics Core Group (2016-2017).
- Expert witness, Strathboss Kiwifruit versus Attorney-General, New Zealand. High Court, Wellington, New Zealand (2017).
- Peer review for *Nature*, *Science*, *Nature Genetics*, *Nature Medicine*, *Nature Microbiology*, *Nature Reviews Genetics*, *Nature Reviews Microbiology*, *PLoS Biology*, *PLoS Computational Biology*, *PLoS Genetics*, *PLoS Pathogens*, *Proceedings of the National Academy of Sciences USA*, *Journal of Virology*, *Genetics*, *Genome Research*, *Molecular Biology & Evolution*, *Molecular Microbiology*, *EMBO J*, *Journal of Molecular Evolution*, *Virology*, *Journal of General Virology*, *AIDS Research and Human Retroviruses*, *American Journal of Tropical Medicine & Hygiene*, *Proceedings of the Royal Society of London Series B*, *Bioinformatics*, *mBio*, *Virus Research*, *Archives of Virology*, *Trends in Genetics*, *Trends in Microbiology*, *Trends in Ecology & Evolution*.

## Research Grants

### Active

- 2020-2023: Revealing the determinants of viral emergence and evolution in fish. CI. ARC. Discovery Project. DP200102351. \$558,470.
- 2018–2022: Redefining virus ecology and evolution. CI. ARC. Australia Laureate Fellowship. FL170100022. \$3,402,903.
- 2018–2020: Using metagenomics to determine the causative agent(s) of tick-borne disease in Australia. CI. NHMRC. Project Grant. GNT1139473. \$639,428.
- 2018–2020: Halting the re-emergence of fatal feline panleukopenia: the role of parvoviral variants and viral co-pathogens in clinical disease in shelter cats. Co-CI (CI, Prof. V. Barrs, University of Sydney). Morris Animal Foundation (USA). \$100,862.
- 2016–2021: The evolutionary and biological bases of host switching in viruses. Co-CI (CI, Prof. C. Parrish, Cornell University). National Institutes of Health (NIGMS). Grant 2 R01 GM080533. \$1,768,591 USD.
- 2016-2021. Centre of research excellence in protecting the public from emerging infectious diseases. Co-CI (CI, Prof. T. Sorrell, University of Sydney). NHMRC. Centre of Research Excellence. GNT1102962. \$2,500,000.
- 2016-2020: The genetic basis of pathogen blocking: elucidating the contributions of the *Wolbachia*, dengue virus and mosquito genomes. Co-CI (CI, Dr. E. McGraw, Monash University). NHMRC. Project Grant. GNT1103804. \$736,338.80.
- 2016-2020: The phylodynamics of human enteroviruses: informing vaccine effectiveness and outbreak preparedness. CI. NHMRC. Project Grant. GNT1099618. \$564,867.70.

### Submitted

- 2021–2025: The evolutionary and biological bases of host switching in viruses. Co-CI (CI, Prof. C. Parrish, Cornell University). National Institutes of Health (NIGMS).

- 2020-2025: Institute of Data Discovery for Health (D<sup>2</sup>H). Co-CI (CI, Prof. G. Leung, University of Hong Kong). Innovation and Technology Commission, Hong Kong.

### *Completed*

- 2016-2019: Making Green Guard® greener: enhancing the efficacy of a biopesticide. Co-CI (CI, Prof. S. Simpson, University of Sydney). ARC. Linkage Project. LP150100479. \$385,000.
- 2016-2018: Genomic dissection and prevention of bacterial transmissions events. Co-CI (CI, Dr. V. Sintchenko, University of Sydney). NHMRC. Project Grant. GNT1103804. \$891,290.
- 2016-2018: Revealing the evolutionary and ecological dynamics of avian influenza virus. CI. ARC. Discovery Project. DP160102146. \$534,100.
- 2014-2017: Defining the evolution of pathogen virulence to enhance rabbit control. CI. ARC. Discovery Project. DP140103362. \$595,000.
- 2014-2016: Cluster-randomised controlled trial to test the effectiveness of facemasks in preventing influenza, corona and other respiratory viruses among Hajj pilgrims. Co-CI (CI, Dr. H. Rashid, The Children's Hospital at Westmead). The Qatar National Research Fund. \$782,812.28.
- 2012-2016: Genomic analysis of the canonical case of virulence evolution: myxomatosis in Australia. CI. National Institutes of Health (NIAID). Grant R01 AI093804-01A1. \$2,806,103 USD.
- 2016. Zika: Open genomic surveillance of Zika virus in Brazil using a novel portable real-time sequencing device. Co-CI (CI, Dr. N. Loman, University of Birmingham, UK). Medical Research Council (UK). (ZK/16-078). £100,000 UKP.
- 2015: PacBio long read sequencer for the Ramaciotti Genomics Consortium of NSW. Co-CI (CI, Dr. M. Wilkins, University of New South Wales). ARC. Linkage Infrastructure. LE150100031. \$630,000.
- 2015. Exploiting genomics to understand pathogen evolution in external infection transmission/evolution and within the normal, obese and immunosuppressed host. Co-CI (CI, Dr. T. Cunningham, University of Sydney). University of Sydney HMR+ Implementation Fund. \$153,913.
- 2014-2017: Black Death genomics and the evolution of pathogen virulence. CI. NHMRC. Project Grant. GNT1065106. \$510,129.50.
- 2014-2015: Towards a real time data sharing to support patient-centred care, quality health delivery, improvement programmes, performance management and research. Co-CI (CI, Dr. J. Morris, The Kolling Institute, Royal North Shore Hospital). Office for Health and Medical Research, Government of New South Wales. \$500,000.
- 2014-2015: Genomic sequencing centers for infectious diseases. Subcontractor (PI, The J. Craig Venter Institute). National Institutes of Health (NIAID). Contract U19AI110819. \$16,200 USD.
- 2013-2016: Genetic variability of non-segmented negative-sense RNA virus populations and host adaptation. Co-CI (PI, Dr. H. Bourhy, Institut Pasteur, Paris, France). Agency National de la Recherche (ANR). No financial support received.
- 2012-2017: Australia Fellowship. CI. NHMRC. GNT1037231. \$4,000,000.
- 2012-2016: The evolutionary and biological bases of host switching in viruses. PI. National Institutes of Health (NIGMS). Grant 2 R01 GM080533. \$1,004,763 USD.
- 2010-2013: Genomic sequencing centers for infectious diseases. Subcontractor (PI, The J. Craig Venter Institute). National Institutes of Health (NIAID). Contract HHSN272200900007C. \$37,752 USD.
- 2010-2012: ARRA: Penn State: ABSL-3 Facility Construction. Consortium investigator. NIH/NCRR (American Recovery and Reinvestment Act). \$14,830,000 (total, all investigators) USD.
- 2009-2012: Detecting homology in the 'twilight zone' of sequence similarity. Co-PI (PI, Dr. R. Patterson, University of California, Davis). National Institutes of Health (NIGMS). Grant R01

GM087410. \$157,070 USD.

- 2009–2013: Fitness and virulence of dengue virus in the context of changing host immunity. Co-PI (PI, Dr. E. Harris, The University of California, Berkeley). National Institutes of Health (NIGMS). Grant R01 GM087405. \$135,040 USD.
- 2008–2013: Dengue vaccine and viral evolution in rural Thailand. Co-PI (PI, Dr. T.P. Endy, The State University of New York). National Institutes of Health (NIAID). Grant R01 GM083224. \$89,988 USD.
- 2008–2013: Evaluation of candidate vaccine technologies using computational models. Sub-contractor. (PI, Dr. D. Burke, The University of Pittsburgh). Bill & Melinda Gates Foundation. Grant 705580-04. No financial support received.
- 2008–2012: Synthesizing the evolutionary and ecological dynamics of acute RNA viruses: comparative analyses and method development. Co-PI (PI, Prof. B.T. Grenfell, Princeton University). National Institutes of Health (NIGMS). Grant R01 GM083983. No financial support received.
- 2008–2012: Emergence of human pathogens in the genus *Bordetella*. Co-PI (PI, Dr. E.T. Harvill, The Pennsylvania State University). National Institutes of Health (NIGMS). Grant R01 GM083113. No financial support received
- 2008–2011: Population dynamics of arboviruses. Co-PI (PI, Dr. J. Aaskov, Queensland University of Technology). National Health and Medical Research Council, Australia. Grant 497203. No financial support received.
- 2007–2012: The evolutionary and biological bases of host switching in viruses. PI. National Institutes of Health (NIGMS). Grant R01 GM080533. \$1,364,796 USD.
- 2006–2010: Intergovernmental Personnel Act (IPA) from National Institutes of Health (FIC). \$146,794 USD.
- 2004–2007: A comparative genomics approach to investigating the origins and evolution of RNA viruses. The Wellcome Trust. (Advanced Training Fellowship for Dr. B. Shapiro). Grant 74717. £158,999 UKP.
- 2003–2006: An experimental and phylogenetic approach to understanding RNA virus evolution. The Wellcome Trust. Grant 71979. £242,643 UKP.
- 2003–2004: The evolutionary epidemiology of sylvatic yellow fever and dengue viruses. The Wellcome Trust. Grant 69552. £120,906 UKP.
- 2002–2005: A bioinformatics analysis of immune escape and viral persistence in hepatitis C virus (with Dr. P. Klenerman). The Wellcome Trust. (Prize studentship). Grant 68610. £105,521 UKP.
- 2002–2005: The population genetics of molecular adaptation in viral pathogens. The Wellcome Trust. (Biodiversity Junior Fellowship for Dr. O. Pybus). Grant 66889. £147,469 UKP.
- 2002–2005: A comparative study of HIV-1 subtypes B and C and the evolution of viral fitness and co-receptor usage (with Dr. L. Morris). The Wellcome Trust. (Biodiversity studentship). Grant 67502. £76,443 UKP.
- 2001–2004: Antigenic evolution in acute human immunodeficiency virus infection: impact of potent anti-viral drugs (with Prof. R.E. Phillips). The Wellcome Trust. (Prize studentship). Grant 65997. £116,541 UKP.
- 2001–2004: The molecular epidemiology of bat lyssaviruses in Europe. The Wellcome Trust (Biodiversity studentship). Grant 64398. £67,279 UKP.
- 2000–2003: The molecular archaeology of *Yersinia pestis* (with Dr. A. Cooper). The Wellcome Trust (Bioarchaeology studentship). Grant 61610. £80,022 UKP.
- 1999–2001: Revealing evolutionary processes from bacterial gene sequences (with Prof. B.G. Spratt). The Wellcome Trust (Prize studentship). Grant 58789. £57,231 UKP.
- 1999–2002: Understanding primate lentivirus (HIV/SIV) diversity. The Wellcome Trust. (Biodiversity Junior Fellowship for Dr. D.L. Robertson). Grant 57073. £105,000 UKP.

- 1998–2001: Evolutionary aspects of recombination in RNA viruses. The Wellcome Trust (Prize studentship). Grant 55819. £54,000 UKP.
- 1998–2001: Revealing the population genetic structure of dengue virus in Viet Nam. The Wellcome Trust (Biodiversity studentship). Grant 54231. £72,000 UKP.
- 1997–2002: Inferring epidemic processes from gene sequences (with Prof. P.H. Harvey). The Wellcome Trust (programme grant). Grant 50275. £430,000 UKP.
- 1995–1998: Automated analysis of gene sequence data banks to reveal the evolutionary and population processes responsible for genetic diversity (with Prof. P.H. Harvey & Dr. S. Nee). BBSRC (Bioinformatics initiative). £125,000 UKP.
- 1995–1998: Inferring population processes from phylogenetic trees (with Dr. S. Nee & Prof. P.H. Harvey). BBSRC (UK). £100,000 UKP.
- 1995: The molecular epidemiology of HIV and HCV in Thailand. The Royal Society. £9,500 UKP.
- 1994–1998: The development of a phylogenetic approach to the molecular epidemiology of viruses. The Wellcome Trust. Grant 41888. £110,000 UKP.
- 1991–1993: Phylogenetic analysis of HIV sequence change within a local infected community (with Dr. A.J. Leigh Brown). Medical Research Council (UK).

## Publications

### *Metrics Summary* (Google Scholar)

- Peer reviewed papers = 594
- Citations = 67,977
- h-index = 136
- i10-index = 531

### **Books**

- **Holmes EC.** (2009). *The Evolution and Emergence of RNA Viruses*. Oxford Series in Ecology and Evolution (OSEE). Series edited by PH Harvey & RM May. Oxford University Press, Oxford. ISBN. 978-0-19-921112-8.
- Page RDM & **Holmes EC.** (1998). *Molecular Evolution: A Phylogenetic Approach*. Blackwell Science Ltd, Oxford. ISBN 0-86542-889-1.

### **Peer Reviewed Journal Articles**

#### *In Press*

- Duggan AT, Klunk J, Porter AF, Dhody AN, Hicks R, Smith GL, Humphreys M, McCollum AM, Davidson WB, Wilkins K, Li Y, Burke A, Polasky H, Flanders L, Poinar D, Raphenya AR, Lau TTY, Alcock B, McArthur AG, Golding GB, **Holmes EC** & Poinar HN. The origins and genomic diversity of American Civil War Era smallpox vaccination strains. *Genome Biol.* In Press.

#### *Published*

594. Andersen KG, Rambaut A, Lipkin WI, **Holmes EC** & Garry RF. (2020). The proximal origin of SARS-CoV-2. *Nat.Med.* **26**, 450–452.
593. Batovska J, Buchmann JP, **Holmes EC** & Lynch SE. (2020). Genome sequence of Yada Yada virus, a novel alphavirus detected in Australian mosquitoes. *Genome Announce.* **9**, e01476-19.
592. Carrai M, Van Brussel K, Shi M, Li C-X, Chang W-S, Munday JS, Voss K, McLuckie A, Taylor D, Laws A, **Holmes EC**, Barrs VR & Beatty JA. (2020). Identification of a novel papillomavirus associated with squamous cell carcinoma in a domestic cat. *Viruses* **12**, 124.
591. Eden J-S, Rockett R, Carter I, Rahman H, de Ligt J, Hadfield J, Storey M, Ren X, Tulloch R, Basile K, Wells J, Byun R, Gilroy N, O’Sullivan MV, Sintchenko V, Chen SC, Maddocks S,

- Sorrell TC, **Holmes EC**, Dwyer DE & Kok J for the 2019-nCoV Study Group. (2020). An emergent clade of SARS-CoV-2 linked to return travellers from Iran. *Virus Evol.* **6**, veaa027.
590. Faye O, Monteiro M de L, Vrancken B, Prot M, Lequime S, Diarra M, Ndiaye O, Valdez T, Tavares S, Ramos J, Leal S da V, Pires C, Moreira A, Tavares MF, Fernandes L, Barreto JN, Teixeira M do C, Mendonça M da L de L, Gomes CC da S, Castellon MS, Ma L, Lemoine F, Gámbaro-Roglia F, Delaune D, Fall G, Fall IS, Diop M, Sakuntabhai A, Loucoubar C, Lemoine F, **Holmes EC**, Faye O, Sall AA & Simon-Lorriere E. (2020). Genomic epidemiology of the 2015-2016 Zika virus outbreak in Cabo Verde. *Emerg.Infect.Dis.* Epub April 29. DOI: 10.3201/eid2606.190928.
589. French RK & **Holmes EC**. (2020). An ecosystems perspective on virus evolution and emergence. *Trends Micro.* **28**, 165-175.
588. Gao W-H, Lin X-D, Chen Y-M, Xie C-G, Tan Z-Z, Zhou J-J, Chen S, **Holmes EC** & Zhang Y-Z. (2020). Newly identified viral genomes in pangolins with fatal disease. *Virus Evol.* **6**, veaa020.
587. Hayward JA, Tachedjian M, Kohlc C, Johnson A, Dearnley M, Jesaveluk B, Langer C, Solymosi PD, Hille G, Nitsche A, Sánchez CA, Werner A, Kontos D, Crameri G, Marsh GA, Baker ML, Pombourios P, Drummer DE, **Holmes EC**, Wang L-F, Smith I & Tachedjian G. (2020). Infectious KoRV-related retroviruses circulating in Australian bats. *Proc.Natl.Acad.Sci.USA.* Epub April 13. <https://doi.org/10.1073/pnas.1915400117>
586. Lam TT-Y, Shum MH-H, Zhu H-C, Tong Y-G, Ni X-B, Liao Y-S, Wei W, Cheung WY-M, Li W-J, Li L-F, Leung GM, **Holmes EC**, Hu Y-L & Guan Y. (2020). Identifying SARS-CoV-2 related coronaviruses in Malayan pangolins. *Nature.* Epub March 26. <https://doi.org/10.1038/s41586-020-2169-0>.
585. Li C-X, Li W, Zhou J, Zhang B, Feng Y, Xu C-P, Lu Y-Y, **Holmes EC** & Shi M. (2020). High resolution metagenomic characterization of complex infectomes in paediatric acute respiratory infection. *Sci.Rep.* **10**, 3963.
584. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, Zhu N, Bi Y, Ma X, Zhan F, Wang L, Hu T, Zhou H, Hu Z, Zhou W, Zhao L, Chen J, Meng Y, Wang J, Lin Y, Yuan J, Xie Z, Ma J, Liu WJ, Wang D, Xu W, **Holmes EC**, Gao GF, Wu G, Chen W, Shi W & Tan W. (2020). Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* **395**, 565-574.
583. Mahar JE, Shi M, Hall RN, Strive T & **Holmes EC**. (2020). Comparative analysis of RNA virome composition in rabbits and associated ectoparasites. *J.Virol.* Epub March 18. doi:10.1128/JVI.02119-19.
582. Marcelino VR, Clausen PTL, Buchmann JP, Wille M, Iredell JR, Meyer W, Lund O, Sorrell TC & **Holmes EC**. (2020). CCMetagen: comprehensive and accurate identification of eukaryotes and prokaryotes in metagenomic data. *Genome Biol.* **21**, 103.
581. Marcelino VR, **Holmes EC** & Sorrell TC. (2020). The use of taxon-specific reference databases compromises metagenomic classification. *BMC Genomics* **21**, 184.
580. Schlub TE & **Holmes EC**. (2020). Properties and abundance of overlapping genes in viruses. *Virus Evol.* **6**, veaa009.
579. Tsoleridis T, Chappell JG, Monchatre-Leroy E, Umhang G, Shi M, Tarlinton RE, McClure CP, **Holmes EC** & Ball JK. (2020). Discovery and prevalence of divergent RNA viruses in European field voles and rabbits. *Viruses* **12**, 47.
578. Tuddenham R, Eden J-S, Gilbey T, Dwyer DE, Jennings Z, **Holmes EC** & Branley JM. (2020). Human pegivirus in brain tissue of a patient with encephalitis. *Diag.Micro.Infect.Dis.* **96**, 114898.
577. Voorhees IEH, Lee H, Allison AB, Lopez-Astacio R, Goodman LB, Oyesola OO, Omobowale B, Dubovi EJ, Hafenstein SL, **Holmes EC** & Parrish CR. (2020). Limited intra-host diversity and background evolution accompany 40 years of canine parvovirus host adaptation and spread. *J.Virol.* **94**, e01162-19.



576. Zhou H, Chen X, Hu T, Li J, Song H, Liu Y, Liu D, Yang J, **Holmes EC**, Hughes AC, Bi Y & Shi W. (2020). A novel bat coronavirus closely related to SARS-CoV-2 contains natural insertions at the S1/S2 cleavage site of the spike protein. *Curr.Biol.* Epub May 10. <https://doi.org/10.1016/j.cub.2020.05.023>
575. Wille M, Harvey E, Shi M, Gonzalez-Acuña D, **Holmes EC** & Hurt AC. (2020). Sustained RNA virome diversity in Antarctic penguins and their ticks. *ISME J.* Epub April 14. <https://doi.org/10.1038/s41396-020-0643-1>.
574. Wu F, Zhao S, Yu B, Chen Y-M, Wang W, Song Z-G, Hu Y, Tao Z-W, Tian J-H, Pei Y-Y, Yuan M-L, Zhang Y-L, Dai F-H, Liu Y, Wang Q-M, Zheng JJ, Xu L, **Holmes EC**, Zhang Y-Z. (2020). A new coronavirus associated with human respiratory disease in China. *Nature* **579**, 265-269.
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