H5N1 research: biosafety, biosecurity and bioethics

Tuesday 3 and Wednesday 4 April 2012

Programme organised by Sir John Skehel FMedSci FRS and Professor Simon Wain-Hobson
Welcome to the Royal Society.
I am pleased that this meeting is taking place here at the Royal Society, to address pressing issues at the cutting-edge of science in a very timely manner.

Influenza has always been of great interest to Fellows of the Royal Society. Our archives contain eighteenth century letters between Joseph Banks and Charles Blagdon discussing influenza, and influenza outbreaks were reported at Fellows’ meetings in the nineteenth century. More recently, in 2006 with the Academy of Medical Sciences, we reported on use of science in preparedness for pandemic influenza, and held a follow-up symposium in 2007. We also convened an international meeting in 2010 to review research on pandemic influenza, including the global response to the new H1N1 virus.

Science, properly applied, is fundamental to health, well-being and economic and social progress. The Society has long been involved in debates within the scientific community about how to strike a balance between openness in science, and security concerns. We work with our sister academies worldwide on biosecurity issues. Later this year, we will publish “Science as an open enterprise”, a major study on how the practice of science is changing, and how openness in science, in particular openness of scientific data, will affect scientists and society.

Influenza is a difficult disease to beat. It also poses broader challenges to the scientific community and to society as a whole. These challenges cross borders, just as science and influenza does. We must consider these challenges fairly and openly, to ensure we can continue making progress in beating the disease. This international meeting will contribute to the debate, and I wish you well with your discussions.

Finally, I would like to thank the programme organisers Sir John Skehel FMedSci FRS and Professor Simon Wain-Hobson, our partners the Academy of Medical Sciences and the Foundation for Vaccine Research, and the American Society for Microbiology, the Bill & Melinda Gates Foundation, Fondation Mérieux, the German National Academy of Sciences Leopoldina, Institut Pasteur, and the Society for General Microbiology for supporting this meeting.

Paul Nurse
President of the Royal Society

H5N1 research: biosafety, biosecurity and bioethics

Synopsis
The journals Nature and Science have recently received papers from two teams of researchers showing that the H5N1 virus could mutate into a form that could spread rapidly among a human population. Various national and international bodies have expressed concern that the safety and security of both the research worker and wider society needs to be considered before work of this kind is published in full. Set against this is the basic principle of openness in science: scientists should operate openly and publish their findings. This conference will discuss virus research, and the safety, security, and ethical aspects from the perspectives of researchers, publishers, policymakers and funders.
## Schedule

### Tuesday 3 April

#### Session 1: The continuing influenza threat
**Chair:** John Skehel FMedSci FRS

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<tr>
<td>9am</td>
<td>Welcome</td>
<td>John Skehel FMedSci FRS and Simon Wain-Hobson</td>
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<tr>
<td>9.15am</td>
<td>Robert Webster FRS</td>
<td>Avian and human H5N1 epidemiology and epizoonosis</td>
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<td>9.45am</td>
<td>Malik Peiris FRS</td>
<td>Risk assessing animal influenza viruses for pandemic threat</td>
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<td>10.15am</td>
<td>Hans-Dieter Klenk</td>
<td>Determinants of the pathogenicity of influenza viruses</td>
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<td>10.45am</td>
<td>Tea/coffee</td>
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<tr>
<td>11.15am</td>
<td>Yoshihiro Kawaoka</td>
<td>Transmission of an influenza virus possessing an H5 hemagglutinin via respiratory droplet in ferrets</td>
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<tr>
<td>11.55am</td>
<td>Ron Fouchier</td>
<td>Aerosol transmission of influenza A/H5N1 virus in ferrets</td>
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<td>12.35pm</td>
<td>Lunch</td>
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#### Session 2: Biosafety, biosecurity and cybersecurity
**Chair:** Simon Wain-Hobson

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<tr>
<td>2pm</td>
<td>Paul Keim</td>
<td>NSABB policy, processes and recommendations on communicating H5N1 research</td>
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<td>2.30pm</td>
<td>Mike Osterholm</td>
<td>Creating a mammalian transmissible H5N1 virus: social contracts, prudence and alternatives</td>
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<tr>
<td>3pm</td>
<td>Thomas Inglesby</td>
<td>Our common goal: protecting public health from avian flu</td>
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<td>3.30pm</td>
<td>Bruce Schneier</td>
<td>Cybersecurity, scientific data and public trust</td>
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<td>4pm</td>
<td>Tea/coffee</td>
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#### Session 3: Public health and bioethics
**Chair:** ?

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<tr>
<td>4.30pm</td>
<td>John Harris FMedSci</td>
<td>Scientific freedom: A two pipe problem with a dual remedy solution</td>
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<tr>
<td>5pm</td>
<td>Ross Upshur</td>
<td>Four normative stances for the management of dual use technologies</td>
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<td>5.30pm</td>
<td>Paul Berg ForMemRS</td>
<td>Asilomar: reflections on an earlier episode in biosafety (by videoconference)</td>
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<td>6pm</td>
<td>End of day one</td>
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**Wednesday 4 April**

**Session 4: Public health and bioethics**  
Chair: John Skehel FMedSci FRS

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<tr>
<td>9am</td>
<td>Gordon Duff FMedSci</td>
<td>Response to H5N1 and H1N1, expérience of the 2009 pandemic</td>
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<td>9.30am</td>
<td>Philip Campbell</td>
<td>A publishing and editing perspective</td>
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<td>10am</td>
<td>Bruce Alberts</td>
<td>H5N1 decisions: some important lessons learned</td>
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<td>10.30am</td>
<td>John Savill FMedSci</td>
<td>H5N1 – a funder’s perspective</td>
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<td>11am</td>
<td>Tea/coffee</td>
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<td>11.30am</td>
<td>Jeffrey Almond FMedSci</td>
<td>Vaccine options: industry perspective</td>
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<td>12 noon</td>
<td>Laurie Garrett</td>
<td>H5N1, the public, public health and public trust</td>
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<td>12.30pm</td>
<td>David Brown</td>
<td>Doomsday virus or no big deal; view from the newsroom</td>
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<td>1pm</td>
<td>Lunch</td>
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**Session 5: ?**  
Chair: Simon Wain-Hobson

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<tr>
<td>2.20pm</td>
<td>Open floor discussion</td>
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<td>4pm</td>
<td>Tea/coffee</td>
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<tr>
<td>4.30pm</td>
<td>Peter Doherty FRS Observations</td>
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<td>5pm</td>
<td>Arthur Caplan Observations</td>
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| 5.30pm| John Skehel FMedSci FRS and Simon Wain-Hobson  
Closing remarks |
| 6pm   | End of day two                         |
Dr Bruce Alberts, Science, USA (Speaker)
Bruce Alberts, a prominent biochemist with a strong commitment to the improvement of science and mathematics education, serves as Editor-in-Chief of Science and as one of President Obama’s first three Science Envoys. Alberts is also Professor Emeritus in the Department of Biochemistry and Biophysics at the University of California, San Francisco, to which he returned after serving two six-year terms as the president of the National Academy of Sciences (NAS).

During his tenure at the NAS, Alberts was instrumental in developing the landmark National Science Education standards that have been implemented in school systems nationwide. The type of “science as inquiry” teaching we need, says Alberts, emphasizes “logical, hands-on problem solving, and it insists on having evidence for claims that can be confirmed by others. It requires work in cooperative groups, where those with different types of talents can discover them – developing self confidence and an ability to communicate effectively with others.”

Alberts is also noted as one of the original authors of The Molecular Biology of the Cell, a preeminent textbook in the field now in its fifth edition. For the period 2000 to 2009, he served as the co-chair of the InterAcademy Council, a new organization in Amsterdam governed by the presidents of 15 national academies of sciences and that was established to provide scientific advice to the world.

Committed in his international work to the promotion of the “creativity, openness and tolerance that are inherent to science,” Alberts believes that “scientists all around the world must now band together to help create more rational, scientifically-based societies that find dogmatism intolerable.”

Widely recognized for his work in the fields of biochemistry and molecular biology, Alberts has earned many honors and awards, including 16 honorary degrees. He currently serves on the advisory boards of more than 25 non-profit institutions, including the Gordon and Betty Moore Foundation.

Dr Jeffrey Almond FMedSci, Sanofi Pasteur, France (Speaker)
Jeffrey Almond is the Head of Discovery Research and External R&D at Sanofi Pasteur, the largest manufacturer of human vaccines, and is based in Lyon, France. In his present role, he is responsible for Sanofi Pasteur’s portfolio of exploratory projects aimed at providing pre-clinical proof-of-concept for a range of human vaccine targets. He also identifies and assesses opportunities for external collaboration on vaccine targets and relevant technologies.

Before joining Sanofi Pasteur in 1999, Jeffrey Almond was Professor of Microbiology at the University of Reading, UK, and served in various offices including chairman of the Virology Division of the International Union of Microbiological Societies, and international secretary for the Society for General Microbiology and member of the UK governmental Spongiform Encephalopathies Advisory Committee. He is currently a member of Council of the Medical Research Council, and an elected fellow of the UK Academy of Medical Sciences.

He has published numerous articles in the field of microbiology especially on influenza and picornaviruses, HIV and vaccines.

Professor Paul Berg ForMemRS, Stanford University, USA (Speaker)
Paul Berg is currently Cahill Professor of Biochemistry, Emeritus. He was born in New York City in 1926, received an undergraduate degree from Pennsylvania State University and a Ph.D. in biochemistry from Case Western Reserve University. He joined the faculty of the Stanford School of Medicine in 1959. Professor Berg was awarded the Lasker Basic Medical Research Award and the Nobel Prize in Chemistry in 1980 for his fundamental studies of the biochemistry of nucleic acids and the development of the recombinant DNA technology. He has received the U.S. National Medal of Science, is an elected member of the U.S. National Academy of Sciences and the American Philosophical Society.
Mr David Brown, Washington Post, USA (Speaker)
David Brown, a journalist and physician, has been a staff writer for The Washington Post since 1991. He has covered medical research, the AIDS epidemic, clinical practice, medical ethics, epidemiology, global health, and numerous non-medical scientific subjects. He majored in American Studies at Amherst College, graduating in 1973. He worked as a reporter at The Greenwood (Miss.) Commonwealth and The Baltimore Sun before entering the Medical College of Pennsylvania, from which he graduated in 1987. He completed a residency in internal medicine at the University of Maryland. He works four days a week at the Post and a day at a general internal medicine clinic in Baltimore supervising medical residents.

Dr Philip Campbell, Nature, UK (Speaker)
Dr Philip Campbell is Editor-in-Chief of Nature and of the Nature Publishing Group. His areas of responsibility include the editorial content and management of Nature, and assuring the long-term quality of all Nature publications. He is based in London.

He has a BSc in aeronautical engineering, an MSc in astrophysics and a PhD and postdoctoral research in upper atmospheric physics. Following his research, he became the Physical Sciences Editor of Nature and then, in 1988, the founding editor of Physics World, the international magazine of the UK Institute of Physics. He returned to Nature to take on his current role in 1995.

He has worked with the UK Office of Science and Innovation, the European Commission and the US National Institutes of Health on issues relating to science and its impacts in society. He is a trustee of Cancer Research UK. He is an elected Fellow of the Royal Astronomical Society and a Fellow of the Institute of Physics, and was awarded an honorary DSc by Leicester University and Bristol University, and an Honorary Professorship by the Peking Union Medical College. He is an Associate of Clare Hall, Cambridge University.

Professor Art Caplan, University of Pennsylvania, USA (Speaker)
Currently, the Sidney D. Caplan Professor of Bioethics at the University of Pennsylvania Perelman School of Medicine in Philadelphia. As of July 1 he will become the Drs William F and Virginia Connolly Mitty Professor and head of the Division of Bioethics at New York University Langone Medical Center in New York City. Prior to coming to Penn in 1994, Caplan taught at the University of Minnesota, the University of Pittsburgh, and Columbia University. He was the Associate Director of the Hastings Center from 1984-1987. Born in Boston, Caplan did his undergraduate work at Brandeis University, and did his graduate work at Columbia University where he received a Ph.D in the history and philosophy of science in 1979.

Caplan is the author or editor of thirty books and over 550 papers in refereed journals. His most recent books are Smart Mice Not So Smart People (Rowman Littlefield, 2006) and the Penn Guide to Bioethics (Springer, 2009). He writes a regular column on bioethics for MSNBC.com and is a monthly commentator on bioethics and health care issues for WebMD/Medscape.

He has served on a number of national and international committees including as the Chair, National Cancer Institute Biobanking Ethics Working Group; the Chair of the Advisory Committee to the United Nations on Human Cloning; the Chair of the Advisory Committee to the Department of Health and Human Services on Blood Safety and Availability; a member of the Presidential Advisory Committee on Gulf War Illnesses; the special advisory committee to the International Olympic Committee on genetics and gene therapy; the ethics committee of the American Society of Gene Therapy and the special advisory panel to the National Institutes of Mental Health on human experimentation on vulnerable subjects. He recently served as the Co-Director of the Joint Council of Europe/United Nations Study on Trafficking in Organs and Body Parts. He is currently the ethics advisor to DOD/DARPA on synthetic biology.

He is a member of the board of directors of The Franklin Institute, the Iron Disorders Foundation and a member of the National Hemophilia Foundation’s Ethics Committee. He is on the Board of Visitors of the Columbia University School of Nursing.
Awards and honors include the McGovern Medal of the American Medical Writers Association, the Franklin Award from the City of Philadelphia, the Patricia Price Browne Prize in Biomedical Ethics for 2011, a person of the Year 2001 from USA Today.

**Professor Peter Doherty FRS, The University of Melbourne, Australia (Speaker)**

Peter Doherty has analysed aspects of viral pathogenesis and immunity for more than four decades, with his major focus over the past 20 years being on the influenza A viruses. He has the privilege of working with two groups of bright young people, at the University of Melbourne and St Jude Children’s Research Hospital, Memphis. These research programs are probing aspects of the innate response and pathology, and the basics of CD8+ T cell recognition, effector function and memory. He is also involved in the public communication of science, and will publish two “lay” books that deal principally with infection and pandemics later this year.

**Sir Gordon Duff FMedSci, Sheffield University, UK (Speaker)**

Gordon Duff graduated in Medicine from St Peter’s College, Oxford, and St Thomas’s Hospital, London, where he also gained a PhD in Neuropharmacology. He held junior faculty positions at Yale University and the Hughes Institute of Molecular Immunology at Yale before joining the Edinburgh Medical School in 1984. In 1990 he took up his present post of Florey Professor of Molecular Medicine at Sheffield University where he was Research Dean of the Faculty and Director of the Division of Genomic Medicine. He currently chairs the Academic Health Sciences Centre of Trinity College Dublin, and the International SAB of the MRC Centre for Drug Safety Sciences at Liverpool.

Previously Chairman of the Committee on Safety of Medicines and its Biological Sub-committee, he has been Chairman of the Commission on Human Medicines (CHM) since 2005. In 2006 he chaired the Secretary-of-State’s Expert Scientific Group on Phase One Clinical Trials, following the disaster at Northwick Park Hospital. From 2002 to 2009 he was also Chairman of the National Biological Standards Board, overseeing the National Institute for Biological Standards and Control. He is an advisor on Biological Medicines to the EU, and Chairman of the UK’s Scientific Pandemic Influenza Advisory Committee (SPI). In 2009-10, he co-chaired, with Govt Chief Scientist, the Cabinet Office’s Scientific Advisory Group for Emergencies (SAGE) during the pandemic flu outbreak. In 2010 he reviewed the UK’s Organ Donor Register at the request of the Secretary-of-State.

**Dr Ron Fouchier, Erasmus MC, Netherlands (Speaker)**

Ron Fouchier received a PhD in Medicine from the University of Amsterdam in 1995, for his studies on molecular determinants of HIV-1 phenotype variability at the Department of Clinical Viro-immunology, Sanquin Research (with Professor Frank Miedema and Professor Hanneke Schuitemaker). He was a post-doctoral fellow at the Howard Hughes Medical Institute, University of Pennsylvania School of Medicine in Philadelphia, from 1995-1998, where he studied the function of the HIV-1 Vif protein, and nuclear transport of HIV-1 pre-integration complexes (with Professor Michael Malim). He subsequently joined the Department of Virology at Erasmus MC to start a new group studying the molecular biology of respiratory viruses, in particular influenza A virus (with Professor Ab Osterhaus). As a fellow of the Royal Dutch Academy of Sciences (KNAW), he studied influenza virus zoonoses and pathogenicity. Recent achievements of his team include the identification and characterization of several “new” viruses; the human metapneumovirus (hMPV), a human coronavirus (hCoV-NL), the SARS coronavirus (SARS-CoV), and a new influenza A virus subtype (H16). Currently, his research is focused on the evolution and molecular biology of respiratory viruses in humans and animals, with special emphasis on influenza virus zoonoses and pandemics. Ron Fouchier is an alumni member of the “Young Academy” of the KNAW and a recipient of the Heine-Medin award of the European Society for Clinical Virology. He is an author of more than 200 publications that received more than 15000 citations. His current research is funded by an NWO VICI grant, an NIAID/NIH contract, several EU programs, and government. Fouchier is an editor for several high-ranked journals in infectious diseases, and member of advisory committees for Dutch government and (international) scientific organisations and conferences. His group is part of an NIH/NIAID Center of Excellence for Influenza Research, and participates in several WHO working groups.
Laurie Garrett, Global Health Council on Foreign Relations, USA (Speaker)

Laurie Garrett is currently the Senior Fellow for Global Health at the Council on Foreign Relations in New York. Garrett is the only writer ever to have been awarded all three of the Big “Ps” of journalism: The Peabody, The Polk and The Pulitzer. Garrett is also the best-selling author of The Coming Plague: Newly Emerging Diseases in a World Out of Balance and Betrayal of Trust: The Collapse of Global Public Health. Her most recent book is I Heard the Sirens Scream: How Americans Responded to the 9/11 and Anthrax Attacks. During her time as Senior Fellow for Global Health at the Council on Foreign Relations, Garrett has written several reports and articles including: HIV and National Security: Where are the Links?, A Council Report (Council on Foreign Relations Press, 2005); ‘The Next Pandemic?’ (Foreign Affairs, July/August 2005); ‘The Lessons of HIV/AIDS’ (Foreign Affairs, July/August 2005); and ‘The Challenge of Global Health’ (Foreign Affairs, January/February 2007), The Future of Foreign Assistance Amid Global Economic and Financial Crisis, A Council on Foreign Relations Action Plan (2009); ‘Castrocare in Crisis’ (Foreign Affairs, July/August 2010). Garrett is a member of the National Association of Science Writers, and served as the organization’s President during the mid-1990s. She currently serves on the advisory board for the Noguchi Prize, François-Xavier Bagnoud (FXB) Center for Health and Human Rights, and the Health Worker Global Policy Advisory Group, and is a Principal Member of the Modernizing Foreign Assistance Network (MFAN). Garrett also chairs the Scientific Advisory Panel to the United Nations High Level Commission on HIV Prevention in collaboration with UNAIDS. She is an expert on global health with a particular focus on newly emerging and re-emerging diseases, bioterrorism, public health and its effects on foreign policy and national security.

Professor John Harris, University of Manchester, UK (Speaker)


Dr Thomas Inglesby, Center for Biosecurity of UPMC, USA (Speaker)

Dr Inglesby is Director of the Center for Biosecurity of the University of Pittsburgh Medical Center (UPMC). The mission of the Center is to increase resilience to natural and deliberate biological dangers and other large-scale catastrophes. Since becoming Director in 2009, he has expanded and deepened the Center’s expertise related to public health threats, establishing new initiatives in emerging infectious diseases and natural disasters, as well as preparedness for nuclear terrorism and accidents.

Dr Inglesby’s work is internationally recognized in the fields of public health preparedness, pandemic flu planning, and biosecurity. Dr Inglesby is Chair of the Board of Scientific Counselors of the US Centers for Disease Control’s Office of Public Health Preparedness and Response. He has been chair or a member of a number of National Academy of Sciences committees, and he has served in an advisory capacity to the Defense Science Board, the Departments of Health and Human Services and Homeland Security, and the National Institutes of Health. He was a member of the National Academy of Sciences expert committee that reviewed the scientific approaches used during the investigation of the 2001 anthrax letters.
Dr Inglesby has been invited to brief White House officials from the past 3 presidential administrations on national biosecurity challenges and priorities, and he has delivered Congressional testimony on public health preparedness and biosecurity. Since 1999, Dr Inglesby has authored or co-authored more than 80 peer-reviewed articles, reports, and commentaries on a wide range of public health and national security issues. In 2010, he co-authored “Necessary Progress in Biosecurity” with Senator Tom Daschle for the Harvard Law and Policy Review. He is Coeditor-in-Chief of the journal Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science, which he helped to establish in 2003 as the only peer-reviewed journal in its field. In addition, Dr Inglesby was principal editor of the 2002 JAMA book Bioterrorism: Guidelines for Medical and Public Health Management. He is regularly consulted by major news outlets for his expertise and insight on issues pertaining to biosecurity, pandemic flu planning biodefense, and response to other public health disasters.

Dr Inglesby is an Associate Professor of Medicine and Public Health at the University of Pittsburgh Schools of Medicine and Public Health. He completed his internal medicine and infectious diseases training at Johns Hopkins University School of Medicine, where he also served as Assistant Chief of Service in 1996-97. Dr Inglesby received his MD from Columbia University College of Physicians and Surgeons and his BA from Georgetown University. He continues to see patients in a weekly HIV clinic.

Professor Yoshihiro Kawaoka, University of Wisconsin, USA (Speaker)
Yoshihiro Kawaoka, DVM, PhD, leads major research programs focused on highly pathogenic viruses including influenza (H5N1 and 1918 influenza viruses) and Ebola virus at the University of Wisconsin-Madison and the University of Tokyo. Dr Kawaoka is the lead author of the manuscript on the ferret transmission studies on the H5 influenza viruses transmissible in ferrets that was submitted to Nature for publication. He has published more than 400 peer-reviewed papers and made important contributions to the field, most notably in reverse genetics systems for influenza and Ebola virus, characterization of host-range determinants, viral assembly and pathogenesis. Dr Kawaoka received the Robert Koch award for biomedical sciences in 2006 and was awarded the Japanese Medal of Honor with purple ribbon in 2011. Dr Kawaoka’s research units have received support from NIAID, Department of Health and Human Services, the Bill and Melinda Gates Foundation, the Japan Science and Technology Agency, the Japanese Ministry of Education, Culture, Sports, Science and Technology, and Theraclone Sciences, a biotechnology company developing novel therapeutic antibodies for the treatment of infectious diseases. He has also received speakers’ honoraria and supplies and equipment for research projects from Chugai Pharmaceuticals, Novartis, Daiichi-Sankyo Pharmaceutical, Toyama Chemical, Wyeth and Glaxo Smith Kline. He owns shares and has other business interests in the company FluGen, which he co-founded. He holds patents and other intellectual property in influenza vaccine and antiviral technology.

Dr Paul Keim, Northern Arizona University, USA (Speaker)
Dr Paul S. Keim (Ph.D.) holds the E. Raymond and Ruth Cowden Endowed Chair in Microbiology at Northern Arizona University, where is also a Regents Professor of Biology. In addition, he directs the Pathogen Genomics Division at The Translational Genomics Research Institute (TGen). Both institutions are based in Flagstaff Arizona. His biological interests span many types of organisms and microbes, but revolve around genetic diversity and its organization in populations and species. This necessarily has involved systematic and phylogenetic analyses to understand how observable genetic diversity is based upon past evolutionary processes. He has published extensively on the evolution and population genetics of Bacillus anthracis, Yersinia pestis, Francisella tularensis, Burkholderia pseudomallei, Burkholderia mallei, Brucella spp., and Coxiella burnetii. His evolutionary genomics has formed the core of the discipline of microbial forensics. Recently, these same principles have been applied to other public health and clinically important pathogens such as S. aureus and E. coli. He is a founding member of the U.S. National Science Advisory Board for Biosecurity (NSABB) and has been the acting board chairman since 2010.
**Professor Hans-Dieter Klenk, Institut für Virologie, Germany (Speaker)**

Hans-Dieter Klenk was born in 1938 in Cologne, Germany. He received his MD from the University of Cologne in 1964 and a degree in biochemistry from the University of Tübingen in 1967. From 1967 to 1970 he was a postdoctoral fellow with Dr P W Choppin at the Rockefeller University in New York. From 1970 to 1985 he held several positions at the Institute of Virology of the University of Giessen. From 1985 to 2007 he was Professor of Virology and Head of the Department of Virology of the University of Marburg where he is now Professor emeritus. His research has focused on the structure and function of enveloped viruses (influenza viruses, paramyxoviruses, filoviruses) with special emphasis on the role of viral glycoproteins and RNA polymerase in the infection process, in pathogenesis and in interspecies transmission. He is author of more than 400 scientific publications. Prof. Klenk was President of the Gesellschaft für Virologie and Chairman of the Virology Division of the International Union of Microbiological Societies. He serves presently on the International Scientific Board of the Institute of Medical Microbiology of Fudan University, Shanghai, on the Scientific Advisory Board of the Pasteur Institute of the Chinese Academy of Science, Shanghai, on the International Scientific Board of the Guangzhou Institute of Biomedicine and Health of the Chinese Academy of Science, and of the Influenza Pathogenesis and Immunology Research Center, Atlanta. He is a member of EMBO and of the Deutsche Akademie der Naturforscher, Leopoldina. His awards include: Preis der Deutschen Gesellschaft für Hygiene und Mikrobiologie (1985), Feldberg Lecture, London (1987), Aronson-Preis, Berlin (1989), Shipley Lecture, Harvard Medical School (2003), Robert-Koch-Medal in Gold, Berlin (2006), Ernst-Jung-Medal in Gold, Hamburg (2008), Emil von Behring-Preis, Marburg (2010).

**Professor Mike Osterholm, University of Minnesota, USA (Speaker)**

Dr Osterholm is director of the Center for Infectious Disease Research and Policy (CIDRAP), director of the NIH-supported Center of Excellence for Influenza Research and Surveillance within CIDRAP, a professor in the Division of Environmental Health Sciences, School of Public Health, and an adjunct professor in the Medical School, University of Minnesota. He is also a member of the Institute of Medicine (IOM) of the National Academy of Sciences and the Council of Foreign Relations. In June 2005 Dr Osterholm was appointed by Michael Leavitt, Secretary of the Department of Health and Human Services (HHS), to the newly established National Science Advisory Board on Biosecurity. In July 2008, he was named to the University of Minnesota Academic Health Center’s Academy of Excellence in Health Research. In October 2008, he was appointed to the World Economic Forum Working Group on Pandemics.

Previously, Dr Osterholm has served as a Special Advisor to then–HHS Secretary Tommy G. Thompson on issues related to bioterrorism and public health preparedness, a member of the Secretary’s Advisory Council on Public Health Preparedness, personal advisor to the late King Hussein of Jordan, and as Minnesota Department of Health state epidemiologist and chief of the Acute Disease Epidemiology Section.

Dr Osterholm is the Principal Investigator and Director of the NIH-supported Minnesota Center of Excellence for Influenza Research and Surveillance and chairs the Executive Committee of the Centers of Excellence Influenza Research and Surveillance network. He is the author of a New York Times best-selling book, Living Terrors: What America Needs to Know to Survive the Coming Bioterrorist Catastrophe, more than 315 papers and abstracts, including 21 book chapters, and serves on the editorial boards of nine journals.

**Professor Malik Peiris FRS, University of Hong Kong (Speaker)**

Malik Peiris is Chair in Virology, School of Public Health at The University of Hong Kong and Director of the Centre of Influenza Research. His current research focuses on the virology, evolution, pathogenesis and epidemiology of animal and human influenza and other respiratory viral infections. He has a particular interest in emerging viral infections and in virus infections at the animal-human interface. In 2003, he played a key role in the discovery that a novel coronavirus was the cause of SARS and in defining the virological aspects of this disease.
Sir John Savill FMedSci, Medical Research Council, UK (Speaker)
Professor Sir John Savill BA, MBChB, PhD, FRCP, FRCPE, FASN, FMedSci, FRSE, a clinician scientist from Edinburgh, took up the position as chief executive and deputy chair of the Medical Research Council (MRC) on 1 October 2010. The appointment is for three years. He was a member of the MRC Council from 2002 to 2008 and chaired two MRC Research Boards during this period.

Between 2008 and 2010 John worked part-time as the chief scientist for the Scottish Government Health Directorates. He was knighted in the 2008 New Year’s Honours List for services to clinical science.

John started his research career with a degree in Physiological Sciences from Oxford University in 1978, followed by degrees in Medicine at the University of Sheffield in 1981. He received a PhD from the University of London in 1989.

After junior hospital appointments in Sheffield, Nottingham and London, he spent seven years in the Department of Medicine at Hammersmith Hospital with spells as an MRC clinical training fellow and Wellcome Trust senior clinical research fellow.

In 1993, he moved to the chair of Medicine, at the University of Nottingham, then in 1998 became professor of Medicine at the University of Edinburgh, where he was the first director of the University of Edinburgh/MRC Centre for Inflammation Research, directing a group interested in the molecular cell biology of renal inflammation.

In 2002, John was appointed as the first vice-principal and head of the College of Medicine and Veterinary Medicine, University of Edinburgh. He retains an ongoing, research active involvement with the University of Edinburgh part-time throughout his appointment as MRC chief executive.

Bruce Schneier, BT Global Services, USA (Speaker)
Bruce Schneier is an internationally renowned security technologist, referred to by The Economist as a “security guru.” He is the author of 12 books -- including his latest best-seller Liars and Outliers: Enabling the Trust Society Needs to Survive -- as well as hundreds of articles and essays, and many more academic papers. His influential newsletter “CryptoGram,” and his blog “Schneier on Security,” are read by over 250,000 people. He has testified before Congress, is a frequent guest on television and radio, served on several government technical committees, and is regularly quoted in the press. Schneier is the Chief Security Technology Officer of BT.

Sir John Skehel FMedSci FRS, National Institute for Medical Research, UK (Organiser and chair)
Sir John Skehel has enjoyed a distinguished career in the field of virology. He has worked for more than 30 years on the influenza virus. He led the team that first deciphered the molecular detail of how the flu virus latches on to and infects a cell, and subsequently how the virus evolves to stay one step ahead of the immune system.

He has worked at the National Institute for Medical Research since 1968, and was its director from 1987 to 2006. He was director of the World Health Organisation (WHO)’s Collaborating Centre for Reference and Research on Influenza from 1975 to 1993. He has received several prizes, including the Wilhelm Feldberg Prize in 1986, the Robert Koch Prize in 1987, the Louis Jeantet Prix de Medecin in 1988, the ICN International Prize in Virology in 1992, knighted in 1996 and the Royal Society Royal Medal in 2003 for “his pioneering research into virology”.

He continues his research at the National Institute for Medical Research and is a member of the scientific advisory committees of several organisations and companies.
Dr Ross Upshur, University of Toronto, Canada (Speaker)

Ross Upshur received BA (Hons.) and MA degrees in philosophy before receiving his MD from McMaster University in 1986. After 7 years of rural primary care practice he returned to complete his MSc in epidemiology and fellowship training in Community Medicine and Public Health at the University of Toronto. He is a staff physician at the Department of Family and Community Medicine, Sunnybrook Health Sciences Centre.

Dr Upshur is the Canada Research Chair in Primary Care Research. At the University of Toronto he is a Professor in the Department of Family and Community Medicine and Dalla Lana School of Public Health, Adjunct Scientist at the Institute of Clinical Evaluative Sciences, an affiliate of the Institute of the History and Philosophy of Science and Technology and a member of the Centre for Environment. He is an Adjunct Associate Professor in the School of Geography and Earth Sciences and Associate Member of the Institute of Environment and Health at McMaster University.

He is a member of The Royal College of Physicians and Surgeons of Canada and the College of Family Physicians of Canada. From 2006-2011, he was the Director of the University of Toronto Joint Centre for Bioethics.

His research interests include the concept of evidence in health care, medical epistemology, clinical reasoning, public health ethics (particularly communicable disease control), empirical approaches in bioethics, primary care research in aging and complex chronic disease, time series applications in health services research, communicable disease and environmental epidemiology. He has over 250 publications including more than 150 peer reviewed publications spanning these domains.

He has been active on Advisory Boards for the International Joint Commission, Doctors Without Borders, and Scidev.net, several medical journals and consulted with the World Health Organization and the Grand Challenges in Global Health.

Professor Simon Wain-Hobson, Institut Pasteur, France (Organiser and chair)

Simon Wain Hobson did his thesis work in biophysics at the University of Oxford. He has been at the Institut Pasteur since 1980 and is most widely known for his work on the molecular biology of HIV, publishing first the sequence in 1985, which turned out to be that of the first primate lentivirus. The enormous genetic plasticity of the virus provided enormous insights into how and where the virus was replicating in vivo. He is holder of licensed patents concerning HIV genomes and diagnostics. Exploiting the theme of genetic editing, he has moved on to cancer research and the role of the APOBEC3 DNA mutators in cancer and other human diseases. He was a professor at 43 and is a member of EMBO and Academia Europaea and is an Officier de la l’Legion d’Honneur. He is a laureate of the André Lwoff and the Athena prizes. In 2010 he co-founded Invectys, a biotech company dedicated to cancer vaccination.

Professor Robert Webster FRS, St Jude Children’s Research Hospital, USA (Speaker)

Robert G. Webster is a Professor in the Division of Virology; Department of Infectious Diseases at St Jude Children’s Research Hospital and holds the Rose Marie Thomas Chair. A New Zealander whose interests include the emergence and control of influenza viruses, viral immunology, the structure and function of influenza virus proteins and the development of new vaccines and antivirals. Together with Graeme Laver he developed one of the first subunit vaccines for influenza that is still being produced in Australia. The major focus of his research is the importance of influenza viruses in wild aquatic birds as a major reservoir of influenza viruses and their role in the evolution of new pandemic strains for humans and lower animals. He has played a major role in the emergence of highly pathogenic H5N1 in Asia and its continuing evolution and control strategies. His curriculum vita contains over 600 original articles and reviews on influenza viruses. He has trained many scientists who now contribute to our understanding of the evolution and pathogenesis of influenza.
The Royal Society

The Royal Society is a self-governing Fellowship of many of the world’s most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society’s fundamental purpose, as it has been since its foundation in 1660, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

The Society’s strategic priorities emphasise its commitment to the highest quality science, to curiosity-driven research, and to the development and use of science for the benefit of society. These priorities are:

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