



UCL

Clinical Operational Research Unit

Annual report

2010

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Introduction

Welcome to the 2010 annual report of the UCL Clinical Operational Research Unit (CORU).

We are a team of researchers dedicated to applying operational research and mathematical modelling approaches to problems in health care. The projects we take on include work with local NHS organisations, those informing national policy and international partners working on global health problems.

On Global Health, Dr Christina Pagel continues to lead our successful collaboration with the UCL Centre for International Health and Development. Recent work includes projects to inform efforts to improve maternal and neonatal health in Asia and Sub-Saharan Africa and the development of a website to enable decision makers in low and middle income states to navigate the published evidence on health financing.

At a national level, in 2010 we worked with the Department of Health on evaluating the use of a vaccine against pneumonia in the advent of another influenza pandemic and estimating the future number of cases of vCJD attributable to the transfusion of infected blood products in the past. We also continued our work with clinicians exploring the role of triage to critical care at times when demand greatly exceeds capacity.

In and around UCL Partners Academic Health Science Centre and other NHS organisations, we've worked on problems related to capacity planning and service configuration, staffing within intensive care, monitoring clinical outcomes and the operation of pharmacy dispensaries.

In addition to delivering on this programme of research and maintaining

our excellent publication record, we have devoted considerable time and energy to active dissemination and knowledge transfer, undertaking a number of consultancy exercises and distributing software tools.

For example, within months of its launch, new software written to implement methods for monitoring clinical outcomes is being used by institutions in several countries, ranging from the US Government Department of Veterans Affairs in their 135 hospitals to an NGO in India working to reduce neonatal deaths. Similar methods are being used as a matter of routine practice at UCLH to monitor surgical wound infections and provide feedback to clinical teams.

We will continue to build on our contacts within the local health economy to maximise the impact of our work. I firmly believe that academic groups such as ours have the potential to play an important role in helping NHS organisations adapt to the financial and structural changes anticipated in the coming years.

The year ended on a sad note with the death of Professor Ray Jackson, who founded CORU and was its Director from 1983-1995. A pioneer of Operational Research with an inexhaustible entrepreneurial spirit and a tremendous zest for life, Ray will be greatly missed. It was Ray who instilled within CORU its ethos of working in close collaboration with front line staff to ensure that our work is relevant to the problems they face and informed by their expertise. He will remain an inspiration as we continue our work.

Martin Utley, Director

The Team

Professor Martin Utley

Director of the unit, Martin joined CORU in 1996 having gained a PhD in high-energy physics. Martin has experience of working on a wide variety of problems in health and health care, spanning many clinical areas. Actively involved in all of CORU's current research, he is committed to assisting those planning, delivering or evaluating health services by developing, adapting and applying operational research techniques. Martin also acts as scientific advisor to the National Confidential Enquiry into Patient Outcome and Death (NCEPOD).

Professor Steve Gallivan

Steve has been active in operational research for over 30 years and served as Director of CORU between 1995 and 2007, devoting his time since then to a variety of research projects. With a PhD in pure mathematics, he started his OR career in traffic engineering before transferring his skills to health. He has over 200 publications and is always looking for new ways of using mathematics in useful applications. In 2009, Steve was awarded the Harold Lardner prize by the Canadian Operational Research Society.

Professor Tom Treasure

Tom joined CORU following a long and successful career as a cardio-thoracic surgeon, during which he collaborated with CORU on research of mutual interest. In his honorary role, Tom contributes his considerable knowledge and clinical experience to ongoing projects concerning outcomes following surgery and hospital acquired infections, as well as conducting his own research regarding the evidence base for thoracic surgery.

Dr Christos Vasilakis

Christos has qualifications in operational research and computer science and has more than ten years of experience as a researcher in health systems. After a number of years lecturing at another London university and having spent a year in Vancouver as a post-doctoral fellow, Christos joined CORU in 2007 as a Principal Research Fellow. He is currently working on projects related to hospital acquired infections and how best to involve clinicians in the development of simulation models.

Dr Christina Pagel

Christina has a background in both mathematics and physics, gaining her PhD in space physics. After 3 years as a post-doctoral physicist in Boston, she decided to make the transition into operational research applied to health care and joined CORU in 2005. In 2008, Christina was promoted to the position of Senior Research Fellow and began leading our work on global health. She is currently working on projects related to maternal child health in low income countries and paediatric cardiac surgery.

Dr Sonya Crowe

Sonya has a background in physics, gaining her PhD in experimental condensed matter physics in 2005. Before joining CORU, she worked for the Government Operational Research Service as a senior OR analyst at the Department of Health. Sonya joined CORU in 2009 and is working on projects related to health protection policy, clinical risk models, and the use of bridging technologies within child heart transplant programmes.

Mr Chris Sherlaw-Johnson

With an academic background in mathematics and operational research, Chris spent many years at CORU working on a variety of projects. Now leading a team within the surveillance division of the Care Quality Commission, Chris retains active research links with CORU in areas of mutual interest and is an Honorary Senior Research Fellow within the unit.

Mrs Mary Gallivan

Mary is a trained nurse who worked for several years as Assistant Director of Human Resources for Hammersmith Hospitals NHS Trust. Since retiring from the NHS, Mary has undertaken short term consultancy work on behalf of the unit in her role as an Honorary Research Fellow. Her in-depth knowledge of the NHS and of hospital management is invaluable to the unit.

During 2010, CORU also benefited from the services of **Dr Andrew Skeen, Dr Francesca Fiorentino, Mr Brian Reddy and Mrs Joanne English.**

Contact details

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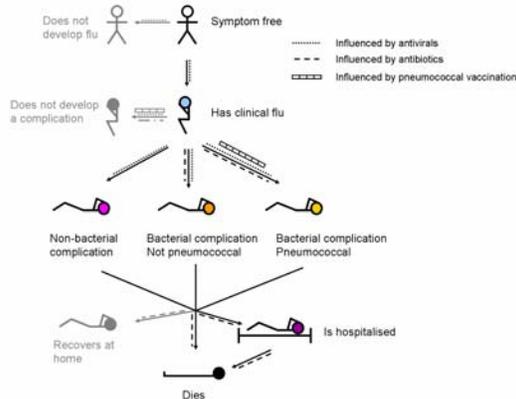
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CORU is hosted by the UCL Department of Mathematics within the UCL Faculty of Mathematical and Physical Sciences.

Example research projects in 2010

CORU conducts research on a wide range of topics. Some of the research projects that the unit was engaged in during 2010 are described below.

Evaluating the role of pneumococcal vaccine in an influenza pandemic



We developed a mathematical model for estimating the number of deaths and hospitalisations that could be avoided by use of a vaccine against pneumonia in the advent of an influenza pandemic. This work directly informed the policy process within Department of Health.

See publication **28**

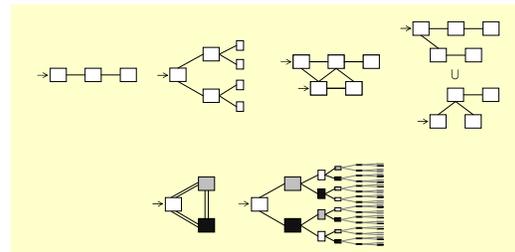
Navigating the evidence on health financing options for low and middle income countries

We have been working with colleagues at the UCL Centre for International Health and Development and Save the Children to review the published evidence on the impact and feasibility of different models of health financing. The second part of the project involved developing a web based tool that will allow policy makers to explore and navigate the evidence generated by the literature review with respect to their own contexts and concerns. This tool is due to be launched in March 2011.

Mathematical analysis concerning the use of bridging technologies in heart transplantation programmes

It is possible to prolong the life of some children awaiting heart transplantation using “bridging” technologies. We are working with surgeons, cardiologists and intensivists at Great Ormond Street Hospital to address a number of questions raised by the availability of this expensive resource. Bridging may increase the chance of an individual patient receiving a transplant and of a donated organ being used. However, these benefits need to be considered alongside the opportunity costs associated with the prolonged use of intensive care beds and the fact that for some patients this burdensome intervention will prove unavailing.

Modelling to assist the restructuring of primary mental health care services

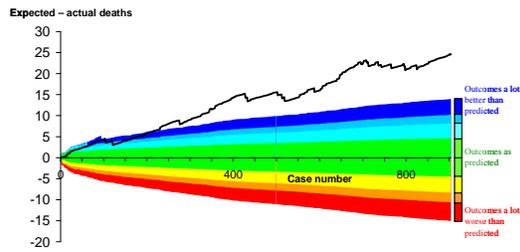


Along with academic partners from the Universities of Exeter and Manchester, we worked with four primary mental health care trusts to develop tools to assist with the reconfiguration of services for people with anxiety and depression.

Novel mathematical models of the flow of people through systems composed of different clinical processes were used as the basis of a software tool now available to services across the UK.

See publications **6, 18**

Risk-modelling in paediatric heart surgery



Audit and clinical governance in adult cardiac surgery have benefited greatly from the existence of a widely accepted model for the risk of peri-operative death and tools developed within CORU for monitoring risk-adjusted outcomes.

No widely accepted risk model exists for use in congenital heart surgery, partly due to the great diversity in diagnoses, co-morbidities and surgical procedures. CORU is working with surgeons and intensivists at Great Ormond Street Hospital for Children and the Central Cardiac Audit Database to establish whether the routine adjustment of surgical outcomes for case mix is feasible.

Triage to critical care in the context of pandemic influenza

Working with consultant intensivists from Great Ormond Street Hospital, we developed simple analytical models to inform thinking concerning processes of triage to determine access to critical care during a pandemic. Our work focussed attention on the need to be clear as to the objectives of triage and explored the nature and scale of differences that would have to exist between different patient groups for triage to have the intended benefits.

See publication **32**

Exploring strategies for reducing maternal and neonatal mortality in low income countries

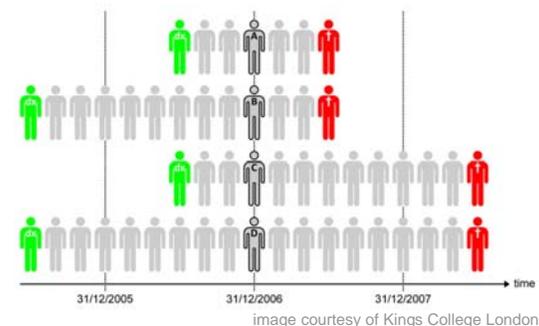
Insufficient progress had been made towards meeting the Millennium Development Goals of reducing maternal and child mortality rates.

We assisted in the analysis of several trials on the effect of community women's groups on neonatal deaths in South Asia. Following up on this work, CORU contributed to UCL consultancy work for the Department of International Development to examine the potential for extending community interventions in India to address malnutrition.

In a separate exercise, we estimated the number of births that will take place in Sub-Saharan Africa and Asia that will not be attended by a skilled birth attendant over the coming decade.

See publications **2, 3, 9, 11, 19**

Trends in cancer prevalence



CORU is working with colleagues at the Thames Cancer Registry to build mathematical models for estimating cancer prevalence over the coming decades. Ultimately, our aim is to provide estimates as to the number of people at each of a number of stages of their disease or recovery with a view to informing the provision of health care and other services for this growing section of the population.

See publication **42**

The surgical removal of pulmonary metastases in colorectal cancer patients

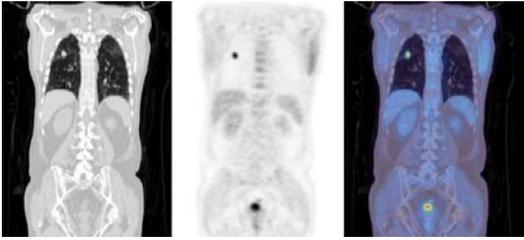
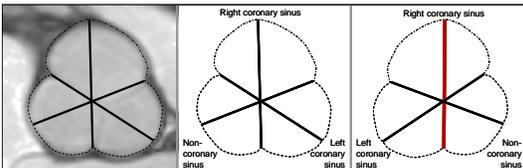


image courtesy of Dr Sally Barrington

The surgical removal of pulmonary metastases in patients with colorectal cancer has become common practice. We have been engaged in a programme of research to challenge the evidence cited in support of this practice and to provide better evidence as to whether surgery confers benefit that outweighs the harmful effects of the operation. This has culminated in the launch of a randomised controlled trial.

See publications **14, 15, 20, 22-26, 36**

An external stent for the Marfan aorta



We have continued to contribute to the evaluation of a new form of surgical management for the most dangerous manifestation of Marfan syndrome. The construction and placement of a bespoke external stent to prevent aortic dissection is the result of an exciting collaboration between engineers, surgeons and radiologists. Our analysis demonstrated the lack of aortic dilation following surgery in the first 10 recipients.

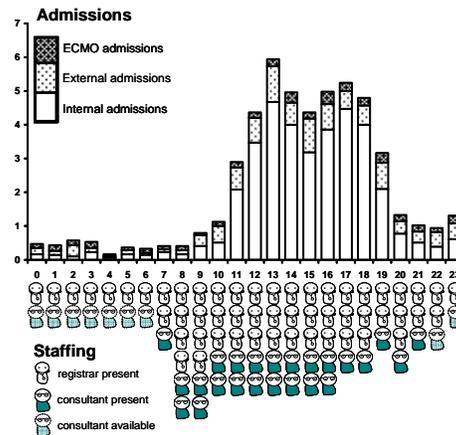
See publications **7, 12, 13**

Assisting the work of NCEPOD

The National Confidential Enquiry into Patient Outcome and Death (NCEPOD) is an organisation dedicated to improving clinical outcomes through the production of research reports based on confidential summaries of cases provided by practicing surgeons, anaesthetists and physicians. We assist NCEPOD in the design of studies and in the analysis and reporting of data.

See publications **29, 30**

Workforce planning in a cardiac intensive care unit



In a short exercise working with consultant intensivists, we compared patterns of admission to cardiac intensive care to staffing levels by time of day and day of week. This work informed decisions regarding future staffing of the unit concerned.

See publication **38**

Other work

In 2010 we also worked on projects related to radical surgery for malignant pleural mesothelioma, the efficient operation of hospital pharmacies, involving clinicians in simulation studies and secondary vCJD infections due to transfusion of infective blood products.

Publications in 2010

Copies of all publications are available on request.

1. Utlely M, Fiorentino F, Treasure T (2010), Obtaining an upper estimate of the survival benefit associated with surgery for mesothelioma, *European Journal of Cardio-thoracic Surgery* **38**:241-4.
2. Azad K, Barnett S, Banerjee B, Shaha S, Khan K, Roselyn Rego A, Barua S, Flatman D, Pagel C, Prost A, Ellis M, Costello A (2010), Effect of scaling up women's groups on birth outcomes in three rural districts in Bangladesh: a cluster-randomised controlled trial, *The Lancet*, **375**:1193-202
3. Tripathy P, Nair N, Barnett S, Mahapatra R, Borghi J, Rath S, Rath S, Gope R, Mahto D, Sinha R, Lakshminarayana, Patel V, Pagel C, Prost A, Costello A (2010), Effect of participatory intervention with women's groups on birth outcomes and maternal depression in Jharkhand and Orissa, India: a cluster-randomised controlled trial *The Lancet*, **375**:1182-92
4. Xie X, Gallivan S, Guinet A, Rauner M (2010), Operational research applied to health services: a special volume dedicated to the international conference ORAHS 2007, *Annals of Operational Research* **178**:1-4.
5. Reynolds M, Vasilakis C, McLeod M, Mounsey A, Newton S, Jacklin A, Barber N and Dean Franklin B (2010) A simulation study of two hospital pharmacy dispensary systems. *Proceedings of the 5th Operational Research Society Simulation Workshop (SW10)*, pp. 266-268.
6. Pagel C, Utlely M, Gallivan S, Vasilakis C, Richards D (2010), Working at capacity: modeling a general mental health care service, *In: Blake J and Carter M. eds., International Perspectives on Operations Research and Health Care*; pp:132-139, ISBN: 978-0-9866179-0-4

7. Pepper J, John Chan K, Gavino J, Golesworthy T, Mohiaddin R, Treasure T (2010), External aortic root support for Marfan syndrome: early clinical results in the first 20 recipients with a bespoke implant, *Journal of the Royal Society of Medicine*, **103**:370-5.
8. Gallivan S, Pagel C, Utley M (2010) Simple sums and useful products - in praise of minimalism, *In: Blake J and Carter M*.eds., *International Perspectives on Operations Research and Health Care*; pp:132-139
ISBN: 978-0-9866179-0-4
9. Prost A, Pagel C, Costello A (2010), Community interventions to reduce maternal and child mortality in low-income countries, *In: Kehoe, S, Neilson J P, Norman, J E*. ed., *Maternal and Infant Details: Chasing Millennium Development Goals 4 and 5* pp: 205-216 ISBN: 978-1-906985-30-1
10. Treasure T (2010), Surgery for mesothelioma: MARS landing and future missions *European Journal of Cardio-thoracic Surgery*, **37**: 509-510
11. Colbourn T, Costello A, Pagel C (2010), Correspondence: Maternal mortality for 181 countries, 1980-2008, *The Lancet*, **376(9750)**: 1390
12. Pepper J, Golesworthy T, Utley M, Chan J, Ganeshalingam S, Lamperth M, Mohiaddin R, T Treasure (2010), Manufacturing and placing a bespoke support for the Marfan aortic root: description of the method and technical results and status at one year for the first ten patients, *Interactive Cardio Vascular and Thoracic Surgery*, **10**: 360-365.
13. Treasure T (2010), The evolution of aortic root surgery for Marfan syndrome, *Interactive Cardiovascular and Thoracic Surgery*, **10**:353-5
14. Treasure T, Fiorentino F, Hunt I, Fallowfield F, Utley M (2010), Current concepts: pulmonary metastasectomy for colorectal cancer, *European Journal of Oncological Medicine*. **11**:2-4.

15. Primrose J, Treasure T, Fiorentino F (2010), Lung metastasectomy in colorectal cancer: is this surgery effective in prolonging life? *Respirology*. 15(5):742-6.
16. Tako A, Kotiadis K and Vasilakis C (2010) A participative modelling framework for developing conceptual models in healthcare simulation studies. In: *Proceedings of the 2010 Winter Simulation Conference*, eds. B. Johansson, S. Jain, J. Montoya-Torres, J. Hugan, and E. Yücesan. Piscataway, New Jersey: Institute of Electrical and Electronics Engineers, pp. 500-512.
17. Tako A, Kotiadis K and Vasilakis C (2010) Developing a conceptual modelling framework for stakeholder participation in simulation studies. *Proceedings of the 5th Operational Research Society Simulation Workshop (SW10)*, pp. 76-85.
18. Richards D, Weaver A, Utley M, Bower P, Cape J, Gallivan S, Gilbody S, Leibowitz J, Lovell K, Owens L, Pagel C, Paxton R, Pilling S, Tomson T and Vasilakis C (2010). Developing evidence based and acceptable stepped care systems in mental health care: an operational research project. Final report. *NIHR Service Delivery and Organisation Programme*, pp. 401.
19. Pagel C, Costello A, Utley M (2010), Community-based interventions to reduce maternal mortality - Authors' reply, *The Lancet*, **375**: 458-459
20. Fiorentino F, Hunt I, Teoh K, Treasure T, Utley M (2010), Pulmonary metastasectomy in colorectal cancer: a systematic review and quantitative synthesis, *Journal of Royal Society Medicine*, **103**: 60-66
21. Treasure T, Treasure J (2010), Smoking cessation, *British Medical Journal*, **340**: b5630

On behalf of the European Society of Thoracic Surgeons, Tom Treasure compiled a supplement for the Journal of Thoracic Oncology including the following manuscripts

22. Treasure T (2010), Carcinoma embryonic antigen: its place in decision making for pulmonary metastasectomy in colorectal cancer, *Journal of Thoracic Oncology* 5(6 Suppl 2):S179-81.
23. Pastorino U, Treasure T (2010), A historical note on pulmonary metastasectomy. *Journal of Thoracic Oncology* 5(6 Suppl 2): S132-3.
24. Fiorentino F, Treasure T (2010), A plea for consistency in the reporting of surgical series illustrated with an analysis of 51 follow-up reports of pulmonary metastasectomy in colorectal carcinoma, *Journal of Thoracic Oncology*. 5(6 Suppl 2):S192-5.
25. Utlely M, Treasure T (2010), Interpreting data from surgical follow-up studies: the role of modeling, *Journal of Thoracic Oncology*. 5(6 Suppl 2):S200-2.
26. Treasure T, Fallowfield L, Lees B (2010), Pulmonary metastasectomy in colorectal cancer: the PulMiCC trial, *Journal of Thoracic Oncology* 5(6 Suppl 2):S203-6.

We supplied the following research reports to the Department of Health for England.

27. Crowe S, Skeen A, Vasilakis C, Gallivan S and Utlely M (2010), Generic mathematical framework for modelling service delivery in a local health economy within the impact assessment tool to assist with emergency planning: final report.
28. Pagel C, Crowe S, Utlely M (2010), A model to evaluate mass vaccination against pneumococcus as a countermeasure against pandemic influenza.

In addition, members of CORU contributed to the following reports

29. Parenteral Nutrition: A mixed bag, National Confidential Enquiry into Patient Outcome and Death ISBN 978-0-9560882-3-9
30. Elective and emergency surgery in the elderly: An age old problem, National Confidential Enquiry into Patient Outcome and Death, ISBN 978-0-9560882-4-6
31. Making Sense of Statistics, Sense about Science and Straight Statistics.

Forthcoming publications

32. Utley M, Pagel C, Peters M, Petros A, Lister P, Does triage to critical care during a pandemic necessarily result in more survivors? *Critical Care Medicine*. doi: 10.1097/CCM.0b013e3181fa3c3b
33. Treasure T, Internullo E, Fiorentino F, Van Raemdonck D, Van Schil P, DeCamp M, Wood D, Utley M, A survey of opinions and beliefs concerning surgery for malignant pleural mesothelioma amongst 802 members of the European Association for Cardiothoracic Surgery (EACTS), the European Society of Thoracic Surgeons (ESTS) and the Society of Thoracic Surgeons (STS), in press, *Interactive CardioVascular and Thoracic Surgery*.
34. Reddy B, Pagel C, Vuylsteke A, Gerrard C, Nashef S, Utley M, An operational research approach to identify cardiac surgery patients at risk of severe post-operative bleeding, in press, *Health Care Management Science*.
35. Tan C, Utley M, Paschalides C, Pilling J, Robb JD, Harrison-Phipps KM, Lang-Lazdunski L, Treasure T, A prospective randomized controlled study to assess the effectiveness of CoSeal® to seal air leaks in lung surgery, in press, *European Journal of Cardiothoracic Surgery*.

36. Fiorentino F, Vasilakis C and Treasure T. Pulmonary metastasectomy in colorectal cancer: analysis of a citation network, in press, *British Journal of Cancer*.
37. Sobolev B, Sanchez V and Vasilakis C. Systematic review of the use of computer simulation modeling of patient flow in surgical care. *Journal of Medical Systems*, in press. doi:10.1007/s10916-009-9336-z
38. Brown K, Pagel C, Pienaar A, Utley M, The relationship between workload and medical staffing levels in a paediatric cardiac intensive care unit *Intensive Care Medicine*. doi:10.1007/s00134-010-2085-0
39. Vuylsteke A, Pagel C, Gerrard C, Reddy B, Nashef S, Utley M, The Papworth Bleeding Risk Score: a stratification scheme for identifying cardiac surgery patients at risk of excessive early postoperative bleeding, *European Journal of Cardiothoracic Surgery*. doi:10.1016/j.ejcts.2010.10.003.
40. Treasure T, Utley M, Surgical Trials, in Randomized Clinical Trials of Nonpharmacologic Treatments, Eds. Boutron I, Revaud P, Moher D, in press, Chapman and Hall
41. Teh E, Fiorentino F, Tan C, Treasure T, A systematic review of lung sparing extirpative surgery for pleural mesothelioma, *Journal of the Royal Society of Medicine*, doi 10.1258/jrsm.2010.100345.
42. Fiorentino F, Maddams J, Møller H, Utley M, Modelling to estimate future trends in cancer prevalence, in press, *Health Care Management Science*.
43. Reynolds M, Vasilakis C, McLeod M, Mounsey A, Newton S, Jacklin A, Barber N, Dean Franklin B (2011) A simulation study of two hospital based pharmacy dispensary systems., in press, *Health Care Management Science*.
44. Treasure T, Pepper J, Aortic root surgery in Marfan syndrome, in press, *Heart*.

45. Treasure T, Senan S, The need for randomised trials in mesothelioma: let's walk the talk, in press, *The Oncologist*.
46. Treasure T, Invited commentary on the paper by Denis et al, in press, *Journal of Neurology, Neurosurgery and Psychiatry*.

Selected presentations 2010

1. A critique of risk scoring, International Congress on Paediatric Cardiac Surgery, Ancona, Italy.
2. More for less: a modeller's dream or a rude awakening? Modelling and Simulation in Healthcare network (MASHNET) event, London.
3. Another bleeding risk model (prize winning poster presentation), 6th IMA international conference on quantitative modelling in the management of health care, London IMA conference, London.
4. What is Operational Research and what has it got to do with health? Royal College of Midwives annual conference. Manchester.
5. Using simulation to design a more efficient hospital pharmacy, 6th IMA international conference on quantitative modelling in the management of health care, London.
6. Applying OR to the problem of paediatric cardiac transplant waiting lists and the use of "bridging technologies", Genoa, Italy.

Working with the best: our collaborators

The contributions of our clinical collaborators and academic partners are essential to CORU's research. In 2010 we benefited in particular from collaborations with

Professor Nick Barber	London School of Pharmacy
Professor Bryony Dean Franklin	Imperial College Healthcare NHS Trust
Professor Henrik Møller	Kings College London
Mr Jacob Maddams	Kings College London
Professor Dave Richards	The University of Exeter
Mr Victor Tsang	Great Ormond Street Hospital for Children
Dr Peter Wilson	University College London Hospital
The Thoracic Unit	Guy's Hospital
Professor Anthony Costello	UCL Institute of Child Health
Dr Audrey Prost	UCL Institute of Child Health
Dr Kate Brown	Great Ormond Street Hospital for Children
Dr Kate Bull	Great Ormond Street Hospital for Children
Dr Alain Vuylsteke	Papworth Hospital
Dr Matt Fenton	Great Ormond Street Hospital for Children
Professor Lesley Fallowfield	University of Sussex
Professor Vern Farewell	MRC Biostatistics Unit
Mr Ian Hunt	St George's Hospital
Ms Carol Tan	St George's Hospital
Dr Paula Lister	Great Ormond Street Hospital for Children
Dr David Cunningham	Central Cardiac Audit Database

Our sources of funding

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