

APPENDIX A: PANEL BIOGRAPHIES

FRANÇOIS SAINFORT (CHAIR)

François Sainfort is the Associate Dean for Interdisciplinary Programs at the College of Engineering and the William W. George Professor of Health Systems in the School of Industrial and Systems Engineering at Georgia Tech. Dr. Sainfort's research and expertise focus on the development of mathematical modeling techniques for medical decision making, health outcomes measurement, health status assessment and monitoring, and health-related performance analysis. Dr. Sainfort has received research funding from the U.S. Federal government – the Agency for Healthcare Research and Quality, the Healthcare Financing Administration, the National Institute of Aging, the National Library of Medicine, the Centers for Disease Control, the National Science Foundation, and the Department of Defense – as well as funding from industry. Dr. Sainfort has published over 100 refereed publications that have appeared in healthcare journals such as *Health Services Research*, *Medical Care*, *Medical Decision Making*, *Medical Care Research and Review*, *Healthcare Financing Review*, *American Journal of Psychiatry*, *The Gerontologist*, *Diabetes Care*, and *Quality of Life Research*. His research has also appeared in operations research journals such as *operations research*, *Journal of Multi-Criteria Decision Analysis*, *Organizational Behavior and Human Decision Processes*, *International Journal of Human-Computer Interaction*, *Journal of Society for Health Systems*, and *Industrial Engineering Research*.

JOHN BLAKE

John Blake is an Associate Professor in the Department of Industrial Engineering at Dalhousie University in Halifax, Nova Scotia. Previously he served as Adjunct Scientist for Canadian Blood Services. He also spent time as Assistant Professor in both the Faculty of Medicine and Engineering since 1997 at Dalhousie. His articles have been published in many refereed journals and books, including *Socio-Economic Planning Science*, *Interfaces*, *European Journal of Operational Research*, *Anesthesia & Analgesia*, *Anesthesiology*, *Surgical Services Management*, and the *Journal of the Society for Health Systems*. His research has been funded by grants from the Nova Scotia Health Research Foundation, the Children's Hospital of Eastern Ontario, Mount Sinai Hospital, Ontario Ministry of Health and NSREC. He is a member of the Association of Professional Engineers of Nova Scotia (APENS), The Institute for operations research and Management Sciences (INFORMS), and The Canadian Operational Research Society (CORS). Last year he became President of the Health Applications Section at the Institute for operations research and the Management Sciences (INFORMS), after first gaining title as Treasurer in 1999. He graduated with a BA of Science in Industrial Engineering from the University of Toronto, and also obtained a PhD there in the same field in 1997.

DIWAKAR GUPTA

Diwakar Gupta teaches in the Graduate Program in Industrial Engineering at the University of Minnesota. This program resides in the Mechanical Engineering Department where Diwakar holds the rank of Professor. Diwakar obtained his PhD in Management Sciences from the University of Waterloo (Canada). Before joining the University of Minnesota, he has taught at the Technical University of Nova Scotia (now part of Dalhousie University) and at McMaster University (both in Canada). His primary research interest lies in the area of Stochastic Modeling with applications to manufacturing systems, inventory management and healthcare delivery systems. His research papers have appeared in such journals as *operations research*, *Management Science*, *IIE Transactions*, and *EJOR*. In the healthcare field, his articles have been concerned with capacity reservation for elective surgeries, pooling of blood samples to reduce the cost of testing for HIV antibodies, and appointments scheduling. Diwakar Gupta is the principal investigator on several sponsored research projects and the director of the Supply Chain and operations research Laboratory (<http://www.me.umn.edu/labs/scorlab/>). One of these projects seeks to understand the success factors of same-day appointments systems and to develop models for improving dynamic assignment of appointment slots to patients. Diwakar Gupta is a Departmental Editor for the *Supply Chain/Production-Inventory*

Systems Department of the journal IIE Transactions -- Scheduling and Logistics. He is also a member of Editorial Boards of several other leading journals.

RONALD L. RARDIN

Ronald L. (Ron) Rardin is Professor of Industrial Engineering at Purdue University and Director of the Purdue Energy Modeling Research Groups. He recently returned from a three-year rotation as Program Director for operations research and Service Enterprise Engineering with the National Science Foundation. Dr. Rardin obtained his BA and M.P.A. degrees from the University of Kansas, and after working in city government, consulting and distribution for five years, earned a PhD at the Georgia Institute of Technology. His current teaching and research interests center on large-scale optimization modeling and algorithms, including their application in healthcare delivery, transportation and logistics, and energy planning. He is an award-winning teacher of these topics, and co-author of numerous research papers and two comprehensive textbooks.

APPENDIX B. SITE REPORTS

Site: Catholic University Leuven
 Ctr voor Ziekenhuiswetenschap
 Kapucynenvoer 35, B-3000 Leuven, Belgium

Date: December 10, 2003

WTEC Attendees: J. Blake (Report author), D. Gupta, M. Carter, T. Bartolucci

Hosts: Lucas Delesie, Professor, Faculty of Medicine, Department of Public Health,
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SUMMARY

The system in Belgium is similar to the systems in Germany and France. Luc indicated that there is a system of compulsory insurance for all individuals in Belgium, funded by payroll taxes. (Luc indicated that 102% of all Belgians are currently insured.) Almost all health services are covered. The monies are distributed to six private insurance funds to pay for services (fully) as well as to hospitals, elder care centers, etc., to fund infrastructure (partially). Regional authorities provide additional infrastructure subsidies; when new hospitals are built, 60% of the capital comes from the community and regional authorities, while the remaining 40% (plus extra amenities) is raised locally. Some private, supplementary insurance exists to cover additional expenses related to private rooms, glasses, dental care, etc.

Administrative costs to insurance firms are made primarily via capitation. Hospitals are funded on a global budget basis using a consensus formula (more on this later). Physician services are reimbursed by the insurance companies on a fee-for-service basis. Most physicians are paid directly or through group practices with pooled funds (some general practices and most hospital physicians) or through wages (teaching hospitals). Rates for physician services are jointly negotiated by the insurance funds, the employers' associations, the various professional bodies and the (supervising) government. Hospitals and physicians have caps on the total number of procedures as well as limits on fees for some of the services they deliver. Caps exist for services such as inpatient days, laboratory tests, and antibiotics for surgery patients. If the caps are exceeded, sliding scales are used to reimburse for additional services or the overruns are recovered the following budget year. A small number (~10%) of physicians in private practice may charge any fee they like.

Hospitals are all not-for-profit organizations. Ownership is either public (local) or private; ownership is split approximately in half between religious and lay organizations (i.e. civic, universities). There are still two regional mental health facilities in Flanders. There has been a trend in public hospitals privatizing through networks of civic institutions or by merging with private hospitals. There is some variation in the hospital management between Flanders (North) and Walloon (South). The Flemish population is more strongly in favor of private hospital ownership than is the Walloon population. Luc noted, however, that issues of supply, demand, and capacity are similar in both the north and the south of the country. Of course, while the issues are the same, the approaches to cope with them differ.

The community (French-, Dutch- and German-speaking communities) and regional authorities (Flanders, Wallonia and Brussels) have decisive influence over hospital planning. Communities decide on the number of hospitals and their location, the number of practicing physicians, the number of funded seats in professional training programs, and even have some say in organizational accreditation.

Healthcare services are, for the most part, over-supplied in Belgium. There are some shortages of community services for the elderly (i.e. homecare) and waits are not unknown for new and expensive diagnostic treatments. However, doctors and hospital beds are in plentiful supply. Luc noted that there is a general prohibition on the over-prescription of antibiotics, but this still takes the form of guidelines to physicians rather than a formal rationing process.

John Blake then asked Luc to describe his research in the past and the present.

Dr. Delesie indicated that he was affiliated with an important Belgian Hospital Federation until 1993. He worked in elder care, mental health, and acute care. His work involved strategy, planning, capacity, and financing. He developed and helped with the implementation of a reimbursement scheme for elder care in 1982. He has been active in developing a hospital financing scheme that determines a hospital's budget. The formula includes a variety of parameters including volume and case mix (Diagnosis Related Grouping or DRG), and type and volume of nursing care (since 1987). Luc also did work to transfer his measurement and financing model to the mental health sector, but notes that progress is slower and that he retired from that particular field of mental health.

Dr. Delesie indicated that he is greatly interested in aspects of measurement. Specifically, his interests relate to finding reliable measures of performance and developing appropriate indicators for health systems. This is not a simple problem, since appropriate measures may not always be on a numeric scale. Accordingly, his research investigates techniques for deriving methods to develop appropriate non-numeric scales and to reach federal consensus on them. He notes that a variety of techniques are used including Item Response Theory (IRT). Luc reminded the panelist that non-physical measures are always culturally and temporally based. In Belgium it is important to develop a consensus for measures that are acceptable to both the Flemish and Walloon populations and across different organizational settings (e.g. home care, nursing home and hospital care for the frail elderly). In addition to language issues, religion, ownership, and provider interests must be balanced within the Belgian system. When pressed for an example, Luc noted that his work in measurement forms the basis for the formulas used to determine elderly care budgets and contributes approximately 10% to the determination of hospital budgets. While most of the indicators used in the formula are process-based in the acute care example, approximately 10% are based on ordinal or non-physical data.

Luc continued with his discussion of measurement, stating that he is very interested in determining measures for difficult-to-quantify items such as need, dependency, severity, qol, performance, professional competency, etc. These very personal concepts are very local and are influenced by culture and timing. To illustrate this point, Dr. Delesie described a discussion he had held earlier in the day with an Irish student. He noted that perceptions about palliative care in Catholic Ireland were likely to be very different from those in England or Scotland even if the language in all three countries is (about) the same. Dr. Delesie went on to describe his work to set appropriate measures for elderly care. He noted, in this instance, that it is important not only to meet the needs of both the north and the south of the country, but also to incorporate the wishes of home care and institutional providers. Luc concluded by noting his measurement work forms the basis of the financing formulas for elderly and acute care. He is working to bring the same framework to mental health, but noted mental health is a tougher problem, requiring substantial groundwork. In the mental health field a great deal of work must be undertaken to set a common language (i.e. should ICD-10 coding be adopted). In addition, conditions in mental health are more difficult to quantify. When, for example, is a person's depression or drug dependency 'cured?'

In addition to his interest in measurement, Dr. Delesie is also interested in applications of visualization (e.g. feedback and communication). He described the importance, for consensus building, of deriving concise information from a disparate dataset and presenting that information to decision makers in an easy-to-understand format. (An example of Dr. Delesie's visualization work can be found in his presentation at the 2003 Operational Research Applied to Health Services (ORAHs) conference in Prague, which appears at the end of this site report.)

The panel then asked Dr. Delesie to comment on other OR research in healthcare in Belgium.

Luc indicated that OR Health Services groups exist at both the University of Leuven (Flemish) and the University of Mons (French). The Mons group is just starting to branch out into the field. The Leuven group has an established reputation within the Center for Health Services, while the Department of Applied Business focuses on traditional OR techniques (wait lines, queues, simulation, etc.) but has a number of students who produce MS-level theses on health services topics. Dr. Delesie indicated that the composition of the students coming through this program is quite varied. His class complement includes approximately 35-50 physicians, 35 healthcare managers, and 42 nurses. All students get an introduction to the domain. Some do thesis work that includes an OR component. Dr. Delesie supervises a number of students and has co-supervised students along with colleagues from the economics department.

The panel inquired about Health Technology Assessment (HTA) in Belgium.

Luc indicated that a group is presently being established and is now hiring staff. He does not feel that the Belgian program will operate entirely on its own. Rather he anticipates strong cooperation with the French and Dutch HTA groups.

Diwakar Gupta asked about research into bio-terrorism or bio-threats.

Luc indicated that there is no bio-terrorism research in Belgium. It is, he feels, an American issue. A civil defence program is in place that undertakes exercises, but there is no research component to these activities.

John Blake asked Dr. Delesie to comment on the state of IT in Belgium.

Luc indicated that the government is interested in the concept of electronic patient records (EPRs) and is itself continuously in the process of redesigning its data warehouse. He indicated that a federal data collection program is in place and that all institutions are required to submit data in a prescribed format (i.e. a minimum data set). He also indicated common coding practices have been adopted across institutions and there is some indication that common standards will be adopted for medical records at some time in the future.

Dr. Delesie indicated that basic information systems are now in place. All institutions collect and contribute towards a national dataset. As an example, he indicated that nursing care data has been collected since 1987 and that efforts are underway to expand the dataset to include a more detailed breakdown of nursing care by type of care program (i.e. geriatrics, ICU, etc.).

Most physicians (~90%) have PCs and are able to collect and transmit data. He noted that automatic prescription generation, requisition of (and feedback on) laboratory tests is common, and that Picture Archiving and Communication Systems (PACS) to the general practitioner (GP) is just starting. As an example of information interchange, Dr. Delesie indicated that physicians are now able to view their patient's radiology results online. Luc indicated that data interchange is possible within the Belgian system because of the large IT influence of the National Insurance Agency and the regulating government and the emphasis on uniform medical records dictated by a number of professional groups.

Data exchange is also possible between hospitals and between hospitals and GPs. Luc indicated that approximately 80% of hospitals are able to send discharge notes to GPs via electronic means. Networks are currently developing that will enable GPs to access full hospital records.

Mike Carter asked if a unique patient identifier is assigned.

Luc indicated that a unique 13-digit patient identifier has existed since 1986 and that the list of insured persons is reviewed annually by the National Insurance Agency. It is now being used for all social program reporting. Interestingly, insurance agencies are allowed to choose their own identification numbering system, so long as it is unique. The number is thus similar to a SSN in the U.S. By using this unique identifier it is possible to trace patient movement through the healthcare system; Dr. Delesie noted that no single data repository exists, however. He believes that it would be impossible for historical reasons.

John Blake asked Dr. Delesie to comment on the state of chronic care in Belgium.

Luc indicated that substantial initiatives in chronic care are underway. He gave home care, day care, and short term-care as examples of chronic care initiatives. His involvement in these programs is primarily in the area of developing and setting indicators, as well as creating financing formulas. Reiterating his earlier point, Dr. Delesie indicated that it is important to seek consensus for the metrics used to evaluate and finance chronic care.

Dr. Delesie also discussed mental health initiatives. At this point, he sees the mental health initiative as a program to design and organize care plans. This is an important part of making improvements to mental healthcare delivery, but it may not be an OR-intense application. Dr. Delesie has already organized the data flow to collect information needed to build a financing formula. Data collection is up and running, but information retrieval is still in the early stage. Luc notes there must be greater experience with the data before people start to debate its meaning.

John Blake asked Dr. Delesie to comment on work in epidemiology.

Luc indicated that there is a substantial epidemiology program in place. As examples, Dr. Delesie cited work in flu spread and vaccination models, as well as breast cancer detection models.

The panel then asked Dr. Delesie to comment on funding sources for research.

Luc indicated that funding comes from the federal government mostly in the form of project grants. The Ministry of Health announces a competition and invites researchers to bid on the projects. Dr. Delesie noted the political nature of the priority-setting process. He also reminded the panel that under EU rules, competition is open to everyone from the EU. Typically, however, grants go to Belgians at least in part because the language of communication must be either Dutch or French. On occasions, research consortiums are formed with researchers from outside Belgium, mostly with researchers from France or the Netherlands.

The meeting concluded with the comment from Dr. Delesie that a great deal of work remains to be done in healthcare. Luc noted that no one has found the silver bullet, yet.

Abstract of Luc Delesie presentation at ORAHS, Prague, Summer 2003

How to Take into Account the Expectations & Preferences of the Clients in Elderly Care

Lucas Delesie

Catholic University Leuven

Abstract

The WHO demands to take into account the expectations of the elderly since 1973. Everybody agrees but few do it: The problem indeed is how? Most organizations, managers, ministers try to measure the prototype, average, model or robot client and to organize and deliver their services accordingly. This case study focuses on the sharp and exact measurement of the client and non-yet clients preferences with respect to a range of existing and future services. It shows how the managers can gain insight and develop knowledge and priorities for their strategy 2010 and program development along the road. The case covers the KBG, the largest Belgian organization for pensioners and its ongoing action plan for the years ahead.

Site: **École Centrale Paris**
Laboratoire Génie Industriel (LGI)
Grande Voie des Vignes
92295 Chatenay-Malabry Cedex, France

Date: November 20, 2003

WTEC Attendees: F. Sainfort (Report author)

Hosts: Professor Yves Dallery
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SUMMARY

Professor Yves Dallery has been at École Centrale, a new school, for about four years. He is currently the Chair of the Industrial Engineering (IE) department. His group's main activity is operations management (OM) applied to manufacturing and supply chain management. However, there is willingness at École Centrale to consider applications in service operations. In particular, he and his colleagues are interested in healthcare delivery systems. Similar interest also exists in other parts of École Centrale.

Professor Yves Dallery's most recent project in the service operations area deals with call center management. He has been working with a company that is a major provider of mobile services in France. He advised one MS student about three years ago, whose master's project was on scheduling surgery rooms in a hospital. This work was well received by hospital administrators. Unfortunately, since then he has not done any new projects directly in the healthcare area. However, along with a doctoral student, he has just started a major healthcare related project. He mentioned that it concerned an issue that is not included in the list of questions WTEC provided to the hosts. The problem deals with operational planning for home care services in France. There is increasing awareness in France that having people stay in hospitals before and after hospital procedures and during the palliative care phase is costly and less desirable from the patient's point of view. An alternative to this approach is to have patients stay at home and bring some services to their homes. The question is whether home care is medically feasible, safe and economical.

He thinks that whereas the first two questions are for the medical professionals, the cost-effective planning for providing such services is clearly an IE/operations research (OR)/OM problem. Issues that arise revolve around cost and service quality. He gave the example of prescription drugs. How should these be delivered to home care patients? Should there be direct delivery from a local pharmacy? Should the delivery come directly from the hospital, or is it better to position warehouses that supply pharmaceuticals to patients in a region? How should visits by medical professionals (MDs, nurses) be organized? He also gave the example of palliative care for cancer patients. Can such care be made cost-effective if the patient stays at home? What services are needed? Which healthcare professionals and how much resources are needed?

École Centrale wants to have a research presence in the healthcare area. A new interdepartmental institute for biotechnology and healthcare has been started. One of the two managers of this institute is an engineer who is connected with the healthcare delivery organizations and has an understanding of what engineering can offer. The home care project will be affiliated with this institute and funding will come from regional social security funds. The student who has started working on this problem has her own fellowship and is already supported.

Professor Dallery mentioned that in order to do good research in healthcare, OR researchers need to spend time in healthcare delivery organizations to understand delivery processes, major issues, and constraints. He commented that healthcare-related papers often have good OR, but are of little value to healthcare professionals. It takes longer to produce usable results. He mentioned that his student is looking at prenatal care as the first type of home care service that could be provided on a pilot basis.

Professor Dallery is scheduled to meet with other French IE department colleagues on December 5th and volunteered to bring the research study questions to this group. He has offered to provide us with a brief

statement of any healthcare-related OR work being carried out and names plus contact information of key individuals involved. He is at present not aware of other researchers/groups working in this area, but suspects that there are some people who are applying mathematical/engineering approaches to healthcare.

Professor Dallery was next asked to comment on the awareness of OR tools and availability of research funding for healthcare OR in France. He thought that until recently, folks in the ministry of health did not have any idea of what OR/OM/IE can offer. However, this has been changing in recent years due to the emphasis on cost containment. He felt that the potential users of OR/OM methods do not fully understand the tools that are available, but that such awareness is less important than recognizing the value of OM/OR-type analysis. He feels that a lot can be learnt/applied from successful techniques developed for manufacturing management since the fundamental issues – cost, service quality, and timeliness of delivery, remain the same.

The NSF equivalent in France is called CNRS, which translates in English as National Center for Scientific Research. This agency funds research in IE/OR. Some healthcare projects are also funded within the IE/OR program. At the time of evaluating applications in healthcare, this group seeks some validation from evaluators in the medical programs. However, in Professor Dallery's opinion, the medical group has not funded research involving the use of OR methodologies to healthcare systems. Overall, Professor Dallery feels that a very small proportion of total research funding is targeted at healthcare applications.

In this context, Professor Dallery also mentioned that IE is only now being recognized in France as a discipline at the national level. Until recently, IE faculty resided in ME and EE (automation/control) departments. Most IE/OR-type research is funded by companies and not by CNRS. He mentioned that the European Commission is also a major source of funding, but that he did not know whether or not they funded healthcare research and to what extent they did.

In closing, Professor Dallery also provided reference of an Italian colleague, Professor Andrea Matta from Polytechnic de Milano, who is working in the healthcare area. Diwakar Gupta will follow up and report if new information about research activities in Italy becomes available.

Site: Erasmus University
Institute for Health Policy and Management (BMG)
Woudestein Complex, Burgemeester Oudlaan 50, 3062 PA
Rotterdam, Netherlands

Date Visited: November 5, 2003

WTEC Attendees: D. Gupta (Report author), T. Bartolucci

Hosts: Dr. Jan Vissers, Professor, Health Operations Management, Eindhoven University of Technology, Tel: +31-40-247-3937, Email: J.M.H.Vissers@tm.tue.nl
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When the meeting was originally scheduled, Dr. Luc Delesie (Leuven) and Professor Johan Mackenbach (Department of Public Health, Erasmus) were also expected to attend. Both could not attend due to other engagements.

SUMMARY OF DISCUSSION

Professor François Sainfort asked Dr. Vissers to explain his past and current research, and the research done by others in the Netherlands that he might be aware of. As part of this question, he also asked Dr. Vissers to explain how the healthcare delivery system is organized in the Netherlands so the panel members could understand which research topics are not relevant to the U.S. healthcare delivery systems. Other questions were posed to Dr. Vissers. What are some emerging challenges for the Dutch healthcare system? Where in his opinion could engineering and mathematical sciences contribute the most? Who funds healthcare OR studies in the Netherlands? What is being done in terms of educating professionals and future researchers? What are the significant research questions for future studies?

Dr. Vissers responded by describing his background first and then making four brief presentations. The first presentation introduced the Dutch healthcare system. The second described networking among the research community in Europe through the European working group the operations research Applications in Health Services (ORAHs, available on the web at <http://www.orahsweb.soton.ac.uk/>). The third explained his past and ongoing research in terms of a framework for healthcare operations management (OM) that he has developed, and the fourth dealt with specific research projects that he is working on. He also answered questions from the panelists during his presentations. What follows is a summary of these presentations and ensuing discussions. In some cases, it was not possible to write down all the details from the PowerPoint presentations.

Dr. Jan Vissers is trained as an Industrial Engineer and Management Scientist. He has been associated with Eindhoven University for over 10 years on a two-fifth full-time equivalent (FTE) basis. He spends his remaining time with Prismant, a non-profit research and consulting company based in Utrecht, where his work has greater emphasis on projects that try to fill the gap between theory and practice. He is in the process of moving to Rotterdam's Erasmus University, where he will devote two-fifths of his time. He will continue to spend his remaining time at Prismant. Dr. Vissers joined the EURO group on health applications about 15 years ago and is the current president of that group.

Dr. Vissers emphasized that his work to date deals with healthcare operations management, as opposed to healthcare operations research (OR). He sees a clear difference in these two approaches. Whereas OR is problem driven, OM takes the managerial perspective. It maps the process first and identifies the central control issues and control levers. Only then does the researcher focus on the problem-solving techniques.

Dr. Vissers mentioned that he has an applied OR background and that Eindhoven University has a strong research center on OM applications in production and logistics. In fact, he is a part of that group applying OM techniques to healthcare. He also mentioned that with the exception of the U.K., OR is not recognized in Europe as a relevant discipline by researchers involved in various aspects of healthcare. He added that in Holland people in healthcare do not understand what OR means and that most research relevant to the WTEC study has been focused on logistics aspects of healthcare. However, there has been an increasing focus on applying OM techniques to healthcare.

Next, Dr. Vissers described two issues that he thought were particularly important for Holland. First, he felt that whereas the organization of networks of service delivery in healthcare had already occurred, this organization was not done from the OM perspective. He gave the example of coordination of “stroke services.” There had been an effort by the healthcare system to streamline services for stroke patients. However, this reorganization was done from the viewpoint of other disciplines (e.g., medical approach), but not from the operations management and logistics perspective. The second point he made concerned the balance between supply and demand for health services in the Netherlands versus other countries in Europe. He mentioned that wait lists were a growing problem in the Netherlands, but that wait lists and congestion were more serious problems in the U.K. and less pressing issues in countries such as France, Belgium, Germany and Austria.

The main points made in his presentation about the Dutch healthcare system are presented in bullet form below.

1. Prismatic collects data for all health services in Holland. This data is available to researchers.
2. The Dutch system is a mix of public and private provisions of services. General practitioners (GPs) are independent service providers. Hospitals are also independent, private and non-profit entities.
3. Public universal insurance is provided to all citizens. It has two components. All exceptional medical expenses are covered 100%. In addition, necessary medical expenses are covered through one of two sources. There is a compulsory social insurance for low-income people (65%) and a voluntary medical insurance for high-income persons (34%). About 1.6% of the population is not insured for necessary expenses. Insurance for less necessary care is entirely on a voluntary basis. Coverage varies widely.
4. Government does not provide medical services. It does, however, regulate the medical insurance and healthcare providers' markets. It also aims to control the total expenditures on healthcare.
5. Cost containment strategies are planned both on the demand side and on the supply side. Holland spends about 8% of its GDP on healthcare expenditures. The expenditures are rising steadily at a mean annual rate of 3.6%.
6. Social insurance payments are deducted from payroll. All monies go into a central fund from which monies flow into different sickness funds (on a risk-adjusted capitation basis).
7. GPs are paid a capitation fee for each sickness fund patient they care for and a fee for each service they provide to privately insured patients.
8. Hospital budgets are based on a complicated formula (it is not based on Diagnosis Related Groupings or DRGs). This formula takes into consideration the number of patients in the service area, the number of licensed beds, the number of specialists and the negotiated volume of output.
9. GPs act as gatekeepers. They are self-employed. Average panel size is about 2300 patients. Patients have free choice of a GP, but must enroll with a practice.
10. Consumers often demand specialist services immediately. In that case, they bypass the GP and go directly to the hospital emergency room. In order to provide after hours and weekend coverage, the GPs have organized to provide urgent care services linked to the emergency department of hospitals. Usually, in a city there are one or two locations where urgent care services are provided and a group of doctors are available for consultation on a rotating basis.
11. GPs specialize in the care of chronic patients. Only 6% of GP contacts result in referrals to specialists. GPs do not own hospital beds, but use diagnostic services at the hospital.
12. For-profit stand-alone specialist services are a fast-growing group within the healthcare delivery system, though they represent only 1—2% of services at the present time. Most specialists are affiliated with hospitals.
13. High-volume, high-efficiency service centers that focus only on certain limited types of procedures (e.g., knee and hip replacement) are also developing fast. This is similar in spirit to the development of diagnostic and treatment centers (DTCs) in the U.K.
14. Hospitals provide both inpatient and outpatient services. The healthcare provider market has seen a number of mergers lately, which has reduced the number of players and amount of competition in the market.
15. Wait lists and wait times have become a political issue. Wait times vary quite a bit. For example, they are in the range of two to four weeks for general surgery and can be as long as 12 weeks for

orthopedics. Hospital waiting times are tracked and can be found by visiting the web at <http://www.nvz-ziekenhuizen.nl/> (in Dutch).

16. Hospital lengths of stay (LOS) have been declining. Average LOS has dropped from 14 days in 1980 to 7.7 days in 2000. Same day surgeries performed on an outpatient basis account for about 40% of all surgeries performed.
17. Major issues for the healthcare system in the Netherlands are:
 - a) Shortage of GPs and high GP workload.
 - b) Vacated GP positions in low-status suburbs.
 - c) Increasing wait lists.
 - d) Shortage of nurses.
 - e) Consumerism – patients demanding more services and direct access to specialists.
 - f) Restructuring of hospital insurance – moving to market competition.
18. Emerging new developments include the following:
 - a) Vertical integration and consolidation in the insurance and providers' markets leading to fewer players and lower competition.
 - b) Transmural care involving efforts to improve continuity of care. Issues addressed here are management of chronic diseases and greater collaboration between primary and secondary care.
 - c) A DRG-based system for hospital reimbursement. The system being developed is slightly different from the U.S. system in that it also includes a fee for the specialist's services.
 - d) Consumer empowerment. Demand/need for making wait time and other performance information about hospitals available to patients.
19. Strengths of the Dutch healthcare system are
 - a) Good primary and secondary care.
 - b) Patient choice (GPs, hospitals).
 - c) Cost containment.
20. Weaknesses of the Dutch system are
 - a) Issues surrounding continuity of care.
 - b) Workload of providers, especially GPs.
 - c) Relatively weak consumers – result of the system that grew as a supply regulated system in which government played a key role in regulating the provision of health insurance and services.

Dr. Vissers talked about the European working group on OR applications in health services. This group has been meeting for about 20 years. Each meeting has about 40 participants. Each participant usually makes a presentation and the meeting lasts one week. The format consists of 30-minute talks followed by some discussion. Typically, either conference proceedings or a special edited volume of the European Journal of Operational Research (EJOR) is produced, consisting of papers presented at the conference. Dr. Vissers showed us some samples of the special issues and conference proceedings in previous years.

Next, Dr. Vissers summarized his own research in health OM by discussing the contents of a book he is preparing on healthcare operations management (a publication of the Rutledge series on Health Management, co-edited with Roger Beech of Keele University). The book focuses on patient flow logistics in healthcare. The major challenge for healthcare OM, in his opinion, is that processes in delivery of healthcare are not managed. These processes involve coordination between organizations and continuity of care remains an issue. Chapter 1 of his book presents the OM perspective and the need for managing processes; Chapter 2 deals with establishing the requirements of a production planning and control approach to healthcare; Chapter 3 defines the operations, processes and approaches – the latter can have unit, chain or network orientation; Chapter 4 is concerned with unit logistics and focuses on the optimal use of resources; Chapter 5 is concerned with chain logistics and focuses on optimizing the throughput of a chain; Chapter 6 is concerned with network logistics and here the focus changes to balancing service and efficiency to provide the appropriate quality of care. A case study-based approach is taken in the book to bring out the main issues in Chapters 3 through 6. The conceptual framework is presented in the first two chapters.

Dr. Vissers talked about the overall conceptual framework, based on the hierarchical levels of decision foci that he formalizes in his book. These decision levels are as follows:

- strategic level decisions
 1. centralized versus decentralized
 2. contracted patient volume
- amount of resources available at an annual level
- time-phased allocation of shared resources
- urgency and service requirements
- scheduling of individual patients

Dr. Vissers talked about several case studies that are in the process of being developed for the book. The conceptual framework was already developed in a series of papers he has written in the last few years, some examples of which are included below.

The first case study develops a map of various processes within each specialty of a hospital where the unit of analysis is a patient group that uses the same process pathway. Each specialty is modeled as a business unit managed by the specialists. In this case study, the hospital acts as a central decision-making organization that plans for capacity requirements at each node of the process.

The second case study concerns admission planning and case-mix decisions. The question here is to determine the ideal mix of patients that should be admitted each day of the week in order to smooth the usage of specialized resources and achieve the minimum threshold of patients in each category that need to be admitted each day to maintain good quality of service to all patient populations. This study utilizes a mixed integer programming formulation of the problem, which is imbedded in a decision support system.

The third case study develops a duty roster (rotation schedule) for specialists using multiple criteria. The model uses a simulated annealing approach, which is imbedded in a decision support system. The aim is to improve an existing schedule, rather than to find the optimal schedule.

The fourth case study develops business planning for surgical specialties by balancing wait lists and output. Wait lists exist for both inpatient and outpatient categories. In addition, a certain amount of capacity is consumed by emergency arrivals. The key question is how many patients in each category should be served? Typically, a common wait list exists for each specialty unless there are some highly specialized service providers whose services are not duplicated by others.

Dr. Vissers showed viewgraphs describing four other case studies. These dealt with the evaluation of priority-setting criteria and their implication on resources, allocation of resources on an annual basis in a hospital setting, modeling the interaction of resources within cardiac care units, long-term resource requirement planning at a hospital, and modeling the impact of service policy orientation in planning. The latter changes focus from resource utilization to service quality.

Dr. Vissers mentioned that the conceptual framework has been developed and that case studies are in the process of being developed. The handbook is expected to be ready for publication in 2004.

At this moment, Dr. Vissers was asked to comment on the extent to which the way of thinking about organizing healthcare delivery systems that he described in his handbook is widely accepted in Holland. Dr. Vissers felt that the OM approach is fairly widely accepted in the Netherlands. He also qualified that the book is aimed at practitioners, in particular hospital managers. He described briefly the educational program in health management at Rotterdam. The program has about 80 graduate and 200 undergraduate students. This topic was discussed in detail with Dr. Rutten who joined us at about this point in time.

Dr. Rutten explained that the Institute for Healthcare Policy and Management operated as a subdivision of the medical faculty, but due to a reorganization, it is now an institute of the Erasmus University at Rotterdam. It is responsible for an undergraduate program in health policy and management and three graduate-level programs. The programs are in the areas of Health Economics Policy and Law, Health Economics, and Health Services Research. Of these, the first two are professional degree programs and the third program has a research orientation. In addition, there is an MS program in health information management and a doctoral program in healthcare delivery. The institute also offers several professional

development courses. For example, it offers a summer program for international managers, in cooperation with the Netherlands Institute of Health Sciences, which draws about 450 students each year.

Dr. Rutten drew attention to the increasing competition among European educational institutions. Many have started BS and MS degree programs, whereas before this split did not exist at European schools which have historically offered a combined degree. In addition, there is a reciprocity agreement between schools in the European Union. Due to this agreement, students pay the same fee as they would pay in their own country and therefore are attracted to the school with the highest reputation. The Erasmus University has started a new International MS program this September that has 52 enrollees. Dr. Rutten also mentioned that there is a similar educational program in Maastricht, but which is smaller. The BMG has about 140 staff positions, of which between 15 and 20 FTEs are utilized in the educational programs. The remaining personnel focus on research. Most of the research positions are funded by research contracts.

There are three main foci of research at BMG. These are health technology assessment (HTA), structure and financing of healthcare, and organization and quality of care. The second stream deals with issues such as competition, insurance, the formula for allocating healthcare funds to different sickness funds based on health risk of the population served, etc. The third group is concerned with logistics and patient flow-type issues, quality and error prevention and reorganization of networks of healthcare delivery systems.

He gave the example of a technique developed by the third group to evaluate the stroke services program in terms of cost-effectiveness and quality and continuity of care. In addition, there is a subgroup that deals with the interaction between process management and information technology.

In response to a question by one of the panel members, Dr. Rutten talked about the disconnect between inpatient and outpatient data. He mentioned that getting longitudinal data on patients is difficult. For these reasons, some data mining techniques are used. In some cases, manual data collection has to be done. In this context, it is useful to develop a supply chain framework. He also mentioned that an electronic patient records (EPRs) concept is being studied. He was not sure whether there were people at Rotterdam looking into this issue.

Dr. Vissers described a web-based system that was developed to track patient flows for cardiac care. In this system, each unit in the chain of care reported the patient arrival time, procedure time and departure time information via the Internet. This information was entered manually. The data is being used to study how the chain should be reorganized.

Both Dr. Vissers and Dr. Rutten were also asked to comment on how supply and demand are matched, particularly in hospitals. Dr. Vissers replied that this is hard to do and that the topic is too broad. He mentioned that in hospitals, beds are assigned to specialists and their numbers are calculated based on demographic information for each region. In nursing homes, beds are provided on the basis of utilization. These two systems of providing capacity induce different types of provider behavior. Whereas it is possible to find empty beds in the hospitals, the nursing home beds are always fully occupied.

Dr. Rutten added that the healthcare system in the Netherlands was in the process of transitioning from a regulated-supply system to a demand-driven system. A major difficulty in realizing a good demand-driven system is achieving equitable distribution of resources. Health insurance premiums are income-based, which are then allocated to insurance companies through risk-adjusted premiums. Individuals do not buy medical services directly. Government manages competition in insurance and provider markets. Many changes have occurred in recent years, but the changes have not been implemented fully, resulting in a system that is a complex mix of public and private insurance companies. The current budget deficit is putting the brakes on the deregulation process, which limits insurance/provider competition.

Dr. Rutten talked about the importance of health technology assessment to the Dutch healthcare system. He said that HTA has always been of interest to the Dutch. In fact, whenever a new intervention is added to the list of benefits covered by insurance, it generates a need to evaluate the cost and benefit of the intervention. The interventions could be new screening programs, organ transplants, or new drugs or therapies. He clarified that the government specifies benefits only in the package offered through the public insurance, but it is customary for private insurance companies to follow suit, and provide the same package to the insured. In this context, Dr. Rutten talked about the increasing importance of drugs as drivers of healthcare costs. Prescription drug prices were not managed before 1991, when reference pricing was introduced. Since 1997, the government has been involved in setting prices for pharmaceuticals. This system is similar

to the Canadian and Australian systems. Pharmaceutical companies must submit information about a new drug before it is adopted in the formulary.

HTA is carried out in the Institute for Medical Technology Assessment (IMTA), which is a part of the BMG. It has about 25 staff members who work on contract research. This is a relatively large group in the European context. Other similar groups exist at York and Sheffield in the U.K., and in Germany. These groups compete for funding from the EU and drug companies (mostly American companies). Another source of funding comes from the need to carry out a cost-benefit analysis of new programs in the Netherlands. The funding for such evaluation is about €10 to 20 million. At the end of each pilot program, new policy guidelines need to be issued and this generates work for the IMTA. There is a proposal to set up a national level institute similar to NICE (National Institute for Clinical Excellence) in the U.K.

The next set of comments by Dr. Rutten and Dr. Vissers concerned the funding situation for research in the Netherlands. The government provides funding to a central research organization, which funds both medical- and natural sciences-oriented research. The research organization formulates programs (or themes) around which funding is provided. Until recently, planning issues in the delivery of health services have not been a part of any program. Program evaluation- and cost-effectiveness-type studies have been funded. This is changing and some recent small grants have been made to studies focusing on planning and organization of services.

Dr. Vissers described the set-up at Eindhoven, where there is a school for production and logistics. This receives monies from the university as well as from the central research organization. The research school uses this money to hire staff as well as to pay stipends to doctoral students. The funding of the research institute at Erasmus is different and comes largely from contract research. PhD students are paid in part from institutional funds and in part from contract research funds. Thus, joining a doctoral program is similar to accepting a job at the university.

Methodology-oriented projects are also carried out by faculty involved in technology assessment. In fact, they are quite popular with research staff. For example, IMTA has been involved in the development of a measure for health status called Euroqual (similar to Qaly) and in the assessment of utility. However, a majority of the projects involve cost-effectiveness analysis. They are funded by the pharmaceutical companies. At this point in time, device manufacturers are not required to demonstrate effectiveness of their inventions and such interventions are usually not evaluated in the same way as drugs are evaluated.

Dr. Rutten commented on the techniques used in health technology assessment. He mentioned that the cost-benefit analysis lies at the core of the assessment and that it may be organized along with a clinical trial. In other cases, assessment may use available data and perform a modeling study of effectiveness. There is a widely accepted methodology for carrying out these studies and several textbooks can be found on that topic.

At the end of this session, Dr. Vissers described some of his ongoing research. These are projects that he is carrying out at Eindhoven University. Some topics being studied are as follows:

1. Integrated planning of operational processes for the ophthalmology specialty in a hospital. This involves planning for different types of patients, e.g., cataracts and others, as well as being able to use a DRG-type compensation system as a basis for planning.
2. Logistic control of multi-symptom vascular disease patients. About 40% of patients have comorbidity factors. The question is how to organize services for these types of patients.
3. Impact of different types of production control strategies. For example, should elective patient procedures be booked and if so, how far in advance?
4. Admission control under multiple resource constraints.

He described the main focus of his research as planning. That means specifying a sequence of events (process) and appointments for patients. The goal is to first classify patients into groups based on a common process sequence (these could be medical inhomogeneous sub-populations). Next, an appropriate plan is developed for each process homogeneous group of patients. This plan may specify patient appointments several weeks into the future (which helps patients), or offer services at a much shorter notice in response to dynamically changing available capacity. The latter approach is used when there is a great deal of uncertainty in capacity usage or in process sequence. At the higher level, planning also includes

resource constraints. The planning approach requires doctors to agree upon the criterion used to classify patients.

A second focus of his research is hospital production control. This centers on the comparison between different control strategies, e.g., choosing the amount of capacity to reserve for emergency patients.

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BACKGROUND

According to 2003-2004 data, INSEAD is one of the world's largest graduate business schools, with significant campuses in Asia (Singapore) and Europe (France). It has approximately 120 faculty in Fontainebleau and 25 faculty in Singapore. INSEAD teaches more than 840 MBA participants, 66 PhD students, and trains approximately 6,500 executives per year.

INSEAD has played a major role in education and research related to healthcare management for quite a while. In particular, INSEAD has a very successful Healthcare Management Initiative (HMI, see <http://www.insead.edu/HMI>), inaugurated in 1996 by John Kimberly. HMI aims to encourage and support innovative and rigorous management research on challenges facing the healthcare sector and to diffuse new knowledge through publication, MBA teaching, Executive Education, and stakeholder consultation. With this initiative, INSEAD is an international point of reference in healthcare management.

In 2002-2003, for example, INSEAD's HMI reported the following new education projects:

- A new Executive Education program for clinician-managers in the British National Health Service (NHS). The program focuses on developing leadership skills for the top hundred English healthcare managers. The education programs include, but are not limited to, leadership training, process management, and total quality management (TQM) training.
- INSEAD also created a business skills training program for health professionals in Eastern Europe, funded by the European Commission and in partnership with GE Medical Systems.
- In 2003, INSEAD also held the sixth edition of the European Health Leadership Programme, designed to provide a select group of individuals with an educational experience that will equip them with concepts, tools, techniques, and strategies to play significant leadership roles in the challenging world of healthcare. The program was a collaborative undertaking with Johnson & Johnson and consisted of a two-week residential program on INSEAD's campus. This program has been very successful over the years and has a strong alumni network of top executives. The programme now runs twice a year.
- As another example, in 2003 as well, INSEAD and Johnson & Johnson held a highly regarded two-day workshop on Innovation and the Future of Healthcare. This workshop occurs biannually.
- INSEAD has developed a teaching case focusing on organizing for innovation in the medical device industry as well as a teaching case focusing on process improvement in healthcare.

Every summer, INSEAD holds a symposium on the future of healthcare. This symposium includes managers in the pharmaceutical industry, the medical devices industry, IT managers, etc. The symposium gathers close to 200 participants from all over Europe. The last symposium focused on IT and advances in information and communication technologies. INSEAD also organized a Healthcare 2020 forum.

A new program will be developed with medical device firms and with a focus on biotechnology research firms. This is in part influenced by the recent Génopole (a technology park around the field of genetics) started close by in Evry by former Prime Minister of France, Lionel Jospin.

In terms of research, INSEAD is very active in the healthcare management area. For example, in 2002-2003, INSEAD's Healthcare Management Initiative reported a number of noteworthy projects, listed below.

- INSEAD developed a research consortium and a proposal to study the role of information technology (IT) in healthcare across Europe.
- INSEAD has built a strong formal relationship with the University Hospital of Leuven, Belgium, to begin studies of leading academic health centers in Europe. One goal of this partnership is to work on cases and papers, and provide a fertile ground for joint collaborative research in healthcare management.
- INSEAD has also begun a study of change projects in the British National Health Service.

Regarding sources of funding to support research and education programs, INSEAD has been very successful, attracting funds from a variety of sources including, but not limited to:

- European Commission
- Healthcare industry funding (Pharmaceuticals, medical devices, etc.)
- British NHS

Obtaining a large amount of EU funding can be challenging as the EU tends to focus more on funding networks of excellence, which requires establishing a number of connections with different EU countries, rather than focusing on individual or small groups of investigators. In that way, funding is somewhat different from federal funding in the U.S., for example, the National Science Foundation.

Prior to addressing specific issues of interest to the NSF panel, Chick remarked that since INSEAD has lots of contact with the U.K. and Benelux in addition to France, some of his comments will pertain to health systems in general rather than specifically in France.

CAPACITY PLANNING/PATIENT FLOW

James Téboul, professor in technology management, has written a number of cases. For example, Karolinska Hospital in Sweden went through a major change from budget-based payment to Diagnosis Related Grouping (DRG)-type funding. Switching to a DRG system caused operations to change dramatically and required a realignment of operations into patient flow lines. This case, while more of a management case than an operations research case, nevertheless illustrates the need for more research, as well as being indicative of the healthcare burden excess and demonstrating that DRG allows for and requires the process to change. The study of service operations is clearly an area requiring more work. There is a lack of formalized research to determine if a shift to DRG has improved quality and/or throughput. INSEAD researchers are pursuing research in this area.

The panel asked whether there are any initiatives on the part of the French government to look at capacity. For example, when a new hospital is proposed and designed, how is capacity set? Chick recognized that there is definitely a role for OR to play in capacity planning. However, Chick is doing relatively less work on this in France now than in other countries, such as the U.K. In terms of government research, there are two main structures in France: Centre National de la Recherche Scientifique (CNRS, National Center for Scientific Research) and the Institut National de la Santé et de la Recherche Médicale (INSERM, National Institute for Healthcare and Medical Research). The CNRS funds primarily nuclear-related research but does fund health and medical studies as well, while INSERM is primarily focused on pharmaceutical research. Chick was less aware of specific funding opportunities from those agencies to support operations research and operations management (OM) work in healthcare.

To address capacity planning issues at the national strategic and tactical levels, Chick suggested the use of dynamic systems concepts to model patient flows and incorporate models from different areas which focus one or two items into a larger dynamic model. As an example, the relationship of the quality of a mammogram screen to the volume and frequency of the screens should be explored. In terms of service system capacity, most models do not include issues related to limited capacity and queue, yet there are queuing effects associated with constrained capacity. Thus, screening standards could be established addressing such issues. Furthermore, there are very different practices for getting screens to individuals, especially if countries are compared (France, U.K., U.S.). Comparative studies would help every country, as everyone is interested in increasing access to quality screens. However, how all the variables related to quality, volume, access, and capacity interact with each other needs to be carefully studied and incorporated into a dynamic model. Such unified models would be very powerful in informing strategic planning. Chick and his group have been working on such issues.

Dr. Jon Chilingirian, with INSEAD's Health Management Initiative, worked with a hospital in Leuven, Belgium, on the consequences of poor capacity planning. A business case was developed on organ transplant programs, specifically a liver transplant based on an incident in which someone came into the hospital needing a liver, there was a liver available, but nobody checked for an ICU bed. The patient recovered in OR for 12 hours. This started a snowball effect for capacity planning. As a result, scheduling software is now in place to schedule OR, ICU, RR, and ward beds. The case is very extensive and talks about how to identify and calculate bottlenecks, how to manage physicians, how to get systems thinking in place. It not only looks at the flow in one institution, but at the flow of patients within a network of possible sites. It addresses how one segment market can take care of different patient lines. Thus, there are a number of interesting areas of research and development including understanding strategy development and implementation, managing flows, and deploying systems thinking concepts. Chick also stressed that there is a need to get OR/OM into the area of strategy.

Gilmartin emphasized that more systems thinking needs to be taught for individuals, especially clinicians, interested in healthcare management. It is critical to expose clinicians to sound management techniques and systems thinking. While the U.S. education system typically exposes its undergraduate students to systems, it is rarely the case in most European higher education systems. INSEAD, on the other hand, emphasizes such an approach.

The panel inquired about the issue of waiting lists in France. Chick remarked that the system in France is highly decentralized with a large freedom of general practitioner (GP) choice. There is, in fact, an overcapacity of GPs. On the other hand, there is an undercapacity of nurses, in part due to the 35-hour work week regulation in France. In turn, the physicians are feeling overworked. The shortage of nurses is estimated to be anywhere between 40,000 to 80,000 nurses. Operationally, the physicians maintain their own records. While many physicians type in the medical history into their own computers, the records are not necessarily linked. The level of care is generally quite high and the overall system is less expensive than in the U.S. Many people have supplemental insurance (Mutuelles d'assurance). Healthcare expenditures represent about 9-10% of the GDP. In terms of inpatient capacity, there seems to be an overcapacity of hospital beds. For example, maternal wards have an overcapacity of beds and a normal birth has a length of stay (LOS) of eight days. Emergency room capacity seems to be about right. In terms of elective surgery, capacity appropriateness is not known and there does not seem to be issues with outpatient settings.

In contrast, Chick remarked that the U.K. has major waiting lists issues and mentioned one example of physicians in Belgium that take overflow capacity from the U.K. for a specific condition. The patients are transported to Belgium and stay in four-star hotels for fast recovery. This is done fairly quickly and cheaply. Such practices raise issues of transnational patient flows. There is a need to use operations research/operations management techniques to investigate the inter-organizational and inter-national levels.

INFORMATION TECHNOLOGY (IT)

While France has "smart cards" with a computer chip (Carte Vitale), the extent and depth of IT use is relatively low. The cards have potential but currently they are primarily used for accounting information. The IT network is flexible, decentralized and available to clients, but not complete. The GPs are not linked. Hospitals have legacy systems and generally have poor information systems. For example, of about 50 hospitals in Paris, perhaps one is a model of modern information technology implementation and use. If one wanted to study patient flow in France, getting appropriate supporting data could actually be quite a challenge. The data is disjointed, there is no central data repository, there is no equivalent to a computerized maintenance management system (CMMS) (ex-HCFA) data center. In contrast, in the U.K., the GPs seem to be better connected, while hospitals are less so. A lot of data is available on the web through the NHS (e.g., for certain types of diseases, for disease management). In France, knowledge growth and data for managing the system are important issues. There is a big push for electronic patient records. Generating and implementing knowledge management tools is perceived as critical.

Chronic Care/Chronic Disease Management

As an example, Gilmartin examined and studied the readiness of East Anglia with respect to meeting national standards for diabetes. She looked at how diabetic services were delivered and investigated organizational factors affecting delivery of care. A key was to tap into expertise and spread to all clinicians.

She found that clinical managers did a lot of education (i.e. best practices). She and her colleagues published a paper on OM factors and how they came to a systems understanding of care. Issues were raised regarding building capacity and building appropriate IT systems. She is working on another paper on building capacity. A key question is whether to invest in IT, and if so, how much. Gilmartin would like to pursue the research and investigate national efforts to implement clinical pathways and how IT can be more efficiently used in this context. For example, the Isreali system is very well organized and integrated from an IT perspective. They have an IT system with complete electronic patient record (EPR) and health cards: Clalit. This organization is integrated, owns pharmacies, IT firms and has perhaps 60% of the Israeli market. This organization would be an excellent case study for best practices.

In the U.K., there is a nurse-lead intermediate care system in areas where there is expertise and there are capacity issues with GPs. Such intermediate care units use triage, are protocol-based (e.g., diet, education, drug regimen), and services are delivered following a group nurse practitioner-type model with some care delivered on-site. The system is in addition to, or in lieu of, the GP system and provides a workable community-based model for chronic care management.

Chick also mentioned Health Hero designed in California, a simulation-based video game for children with diabetes, providing handheld calculators for determining insulin levels and enabling patient self-care. Such successful cost-effective self-care systems should be more widespread. Few cost-effectiveness/quality studies are conducted. Performance outcomes measurement is not yet part of the culture among practitioners. Practitioners understand the revenue function but not necessarily the cost function (and tracking costs is itself an additional expense).

Asked about other studies of the creative use of IT, Gilmartin mentioned Spain, which has a fairly sophisticated disease management program relying on IT: the Diabetic Consortium in Madrid. She also remarked that most IT development occurs in the area of telemedicine. She also mentioned STAKAS, a large telemedicine project in Finland for healthcare delivery with a significant research component built into the project. She also observed that Wales is investing in IT as a way of caring for a relatively large rural population. For example, radiologists now read screens remotely via information technology. Also, mobile units have been designed to provide distance consults, radiology readings, as well as drug issuing. A practitioner-to-practitioner network is being implemented.

Epidemiology and Public Health

Under the leadership of Professor Chick, a strong OR group is pursuing state-of-the-art research in public health by developing sophisticated stochastic infection models for AIDS and other STDs, modeling infection/transmission rates in novel and powerful ways, and developing new associated risk-assessment methods. In the future, the objective is to eventually consolidate the various techniques and models into tools that will assist decision-making processes in various fields, such as secondary transmission risks and water treatment decisions (the latter in cooperation with the U.S. EPA). Chick and his colleagues are leading modern risk assessment research along a hierarchy of modeling techniques involving increasing levels of complexity: from systems dynamics models, to stochastic models, to microsimulation models, and finally to dynamic social network models (e.g., Riolo, Koopman and Chick 2001). These techniques, and especially their integration into usable decision support tools, hold great promise for the analysis, control and surveillance of infectious diseases as well as in the analysis of the effectiveness of health interventions and technologies.

Chick also cited other researchers in Europe performing related work. These include, but are not limited to:

- Neil Ferguson of Imperial College London (performing work with ordinary differential equations (ODE) and stochastic models with applications for Mad Cow disease)
- Marion Rauner of the University of Vienna (performing work on infection rates)
- Ruth Davies of the University of Warwick and Sally Brailsford of the University of Southampton in the U.K. (performing work in microsimulation)

Chick is also looking to pursue work dealing with model transition issues, i.e., how to assist the decision maker in transitions from one model level to another level. Chick is also interested in mutation and disease resistance. In particular, modeling disease changes as well as how treatment modalities respond to such changes is an area that should be investigated in more detail. In addition, the effect of different policies and intervention strategies could be incorporated into such models.

Chick also suggested research go beyond patient flow issues and move into how operations management and operations research can and should influence policy levers to improve public health at a macro level. Support for such ideas could be funded, for example, by the Gates Foundation Global Health Grand Challenges program and tested in underdeveloped countries.

Health Technology Assessment

In terms of health technology assessment, Chick and colleagues have collaborated with peers in the U.K. For example, they performed an analysis of HTA programs in the U.K. to evaluate whether such programs have an impact on policy. A disconcerting finding was that 45% of 65 medical technologies examined and used appear to have little research-based evidence to support claims of effectiveness and thus, do not have a robust enough research base to support policy. In fact, in this work, they found only two policies with sufficient statistical power. Furthermore, many practice standards appear to have been designed on studies involving less than a dozen patients. These findings suggest a need to fund groups of researchers, rather than individuals to improve performance all across the board. A different model of innovation seems to be required in the healthcare delivery sector.

Biotechnologies

The group asked Chick whether INSEAD is involved in research involving biotechnologies. Chick observed that there is a lot of innovation in this area, especially with regard to testing (e.g., test on a chip), diagnosis, tissue analysis, and rapid analysis of etiology. While these innovations have potential to reduce patient flow waiting times (especially for conditions where diagnosis is a significant problem), they also potentially raise important technological and organizational infrastructure issues. It also leads to further disease segmentation. For example, breast cancer is no longer seen as a monolithic disease, but as a class of similar conditions. This leads to important problems of customized drug/treatment development and administration, along with patient segmentation, triage and assignment issues. It also raises further resource allocation problems with respect to, for example, research dollar allocation. These issues offer important opportunities for operations researchers.

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SUMMARY

Dr. Worthington indicated that he has been working in the area of operations research (OR)/operations management (OM) and healthcare management for the past 25 years. Over this period he has been involved in numerous lines of research. During this time he has dropped some lines of research, and continued others.

Dr. Worthington expressed an ongoing interest in wait list management issues and appointment scheduling systems. In the past several years, he has had a great deal of interaction with NHS, mostly in the area of wait list management. Recently this has included work with the Modernization Agency. He noted that the Waiting List Team of the Modernization Agency has two people active in OR; these individuals report to the Leeds-based OR group, but have the Modernization Agency as their primary focus.

Dr. Worthington describes efforts by the National Health Service (NHS) Wait List Initiative as being focused on encouraging good wait list management practices in hospitals (e.g. forming a single wait list for services). NHS is promoting this initiative which is about bringing out good ideas based on OR principals, implementing them at a local level, and then publicizing success stories. Dr. Worthington listed as an example a scheme called Clinical Prioritization. This is an effort to get clinicians to set priorities for their patients and then to treat patients in first-in first-out (FIFO) order to achieve clinical goals.

John Blake asked about the scope of the Modernization program. Is it limited to London or is it a broader initiative?

Dr. Worthington indicated that the Modernization initiative is a broad, system-wide initiative. There are several projects within the initiative (for example, radiology services), but the projects potentially encompass the entire NHS. Projects are sponsored by teams that go out to local hospitals and apply concepts to the area of interest. By focusing on local issues, the team gets buy-in. Once projects are underway, the team gathers success stories and publishes them to promote dissemination of ideas.

John Blake then asked if projects, such as the Wait List Initiative, fall under the rubric of the NHS R&D program or are strictly the focus of the Modernization Agency.

Dr. Worthington indicated that the Modernization Agency is the sponsor and promoter of the Wait List Initiative. The Agency uses individuals in a consultancy role to undertake projects. Included in the Agency's staff complement are two individuals with an OR focus who provide modeling support.

Most of Dr. Worthington's work with NHS takes place through graduate student projects. In the previous year, he was involved with two projects. One project was a "top-down" model, in which the student team developed a set of tools in Access and Excel to analyse nationally available data to identify Trusts with good (or bad) wait lists. The second project was a "bottom-up" approach to assist a local hospital Trust in making use of Improvement Leaders' Guides. Improvement Leaders' Guides are documents that outline solutions to common operational issues. He noted that in many clinical environments, decision makers are simply too busy to take on the additional burden of operational improvement projects. This initiative gets around some of the initial learning curve in process improvement by inserting analysts to initiate a project. They involve hospital decision makers and do some education and training in OM techniques such as process mapping, quality control, and Business Process Reengineering (BPR). The team builds up expertise at the local hospital and guides them through the improvement process. Using success stories, the team

develops guidelines for decision makers in other institutions who may be facing similar issues. The analysts disseminate the findings and act as a resource for individuals in other Trusts.

As an example of a project of this type, Dr. Worthington described recent work with ophthalmology wait lists in outpatient clinics. He noted that there are two general areas to deal with: the wait time within clinics and the backlog of cases waiting to gain entry to the clinic. Within clinics, wait times are best handled by improved appointment scheduling. Backlogs are a capacity management issue. He also noted that a certain amount of customization is always necessary when conducting an improvement project at a particular institution. Trusts may have unique characteristics that invalidate general improvement protocols or customization may be necessary to prove compatibility and to secure local buy-in.

John Blake then asked about the focus of research activities in the U.K. Is the majority of effort focused on health technology assessment? Is there a significant research effort in the area of operations management or operations research? Dr. Worthington acknowledged that there is a long and established program of research in the area of technology assessment. He noted that the work of people in Southampton to model disease progression was well-established and well-known. Efforts in this area have been promoted by national funding agencies. He also noted that research related to the field of health technology assessment is being undertaken in Sheffield and York. Researchers at these institutions have an interest in cost-effectiveness studies and have developed sophisticated modeling concepts. Dr. Worthington sees the work done at Sheffield and York to be a complement to randomized clinical trials. Some of the modeling techniques being employed include stochastic models, Bayesian analysis, and Monte Carlo simulation to evaluate cost-effectiveness over a range of uncertain parameter values.

Dr. Worthington pointed out a recent collaboration between the Universities of Sheffield and Lancaster. Each year, someone from Sheffield provides a lecture to Lancaster's graduate students, and for the last two years MS students have done projects with the Sheffield group (SchARR). This year, he has had a student working on Bayesian approaches to identify the value of perfect information for screening programs. In instances where conducting a full set of simulations on uncertain parameters is computationally daunting, other techniques for measuring a response surface must be developed. He described his student's work to create meta-models to estimate the response surface, which was combined with regression to estimate the value of perfect information.

Dr. Worthington returned to the idea of the differences between North America and the U.K. Engineers in North America tend to be more involved in operations work; technology assessment is the traditional domain of economists in North America.

Dr. Worthington highlighted the importance of applying OR at the strategic level. He noted the large number of issues crying out for a modeling approach. Operations researchers, he argued, bring a different perspective to problem solving and enhance the synergy of multi-disciplinary research teams.

John Blake inquired about the type of work that should be done in the future.

Dr. Worthington indicated that great potential exists in the area of simulation-based models for hospital improvement. He doubts that any completely generalizable model can be invented, but suggests that decision makers are attracted to general improvement proposals. He feels a niche exists for customizable models that can be applied across a variety of institutions. As an example, Dr. Worthington described a simulation to determine if, or under what circumstances, booked admissions are a good idea. He also noted the importance for OR people to get a foot in the door when new policies are rolled out. Only by contributing to the development of these policies, can OR people hope to have an impact on the function of the system.

John Blake then asked Dr. Worthington to comment on research in IT. Dr. Worthington indicated that his experience with IT is as a user, rather than a designer. He uses IT systems extensively to build decision support tools for planning activities. He noted his recent work with Primary Care Trusts (PCTs) to undertake commissioning activities. Commissioning activities require PCTs to undertake a needs assessment and to compare a region's needs with the services actually delivered.

Dr. Worthington's work was funded by the Regional Health Authority, in conjunction with several local Trusts. The project title was Information Support for Healthcare Purchasing. His work involved consulting on the development and use of Geographic Information Systems (GIS) to compare service needs and service delivery. GIS systems, he noted, are particularly adept at bringing together a range of information.

However, some knowledge of healthcare delivery is needed to create meaningful information from the mass of data available. His work involved pre-processing data prior to its import into a GIS to account for population risk-adjustment and to increase the statistical power of the information coming from the system (i.e. standardizing admission rates).

John Blake asked about funding for projects.

Dr. Worthington indicated that much of his funding comes from the local Health Authority and local Trusts. He also noted that Lancaster has a program where graduate students complete projects in local firms. Students act in a consultant role on a project. Firms, in return, fund student positions. Students are closely supervised by faculty to ensure good results. In general, he takes on projects that come along with a health flavour.

Dr. Worthington has not tried recently to access funds via the NHS R&D program, although he has undertaken regionally funded work of this sort. He notes that there is a regular flow of money through the HTA program and that it largely goes to researchers established in the field. New researchers may have difficulty accessing these funds. He also indicated that Lancaster is a pre-authorized research center under the NHS SD & O program.

John Blake asked Dr. Worthington to comment on OR education for healthcare professionals.

He indicated that education was primarily delivered through the school's graduate and undergraduate programs, and none of it is currently directly targeted at healthcare professionals. Lancaster provides a graduate degree in OR which includes a module on public sector management. Since most of the faculty within the stream is interested in healthcare, the module has a significant healthcare component. At any given time there are 40-50 graduate students in OR, of which 25-30 graduate and take the Public Sector Applications module. There are also 50-60 undergrads in training.

Education for clinicians (mostly nurses) is provided through a MA in Health Research. As part of this program, a course in Operational Research was offered and was well received. More recently, student numbers have declined and the course has been withdrawn. Dr. Worthington also has provided support for an HMBA offered through the University of Keele.

John asked Dr. Worthington to comment on work done in the realm of patient flow and capacity planning.

He noted that patient flow is a rich area of research; he plans to continue work in the area, noting that he has a real interest in problem-driven research. He highlighted his work in appointment booking systems as an example of the type of work in patient flow and capacity planning that he hopes to do.

Dr. Worthington suggested that capacity planning is always something of an issue in NHS. He noted that programs are frequently brought forward to address supply and demand issues. However, the fundamental problem of a mismatch between supply and demand is almost never addressed. Even if more money is thrown at the problem, odd results occur. For example, when capacity for a particular type of treatment is expanded latent demand appears and wait time is not seen to improve.

He also noted that he is more than happy to contribute to the macro problem of aligning supply with demand. Exactly how that should be accomplished is an open question.

Finally, John Blake asked Dr. Worthington if he could highlight the difference between the National Institute for Clinical Excellence (NICE) and the NHS Health Technology Assessment (HTA) program.

He noted that NICE tends to provide advice to physicians and managers about new and emerging technologies, often specific drugs or medical devices. The NHS HTA program looks at basic research into effectiveness and may involve technologies for which there is no commercial sponsor (i.e. surgical techniques) or technologies that have already been implemented.

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Date Visited: November 4, 2003

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OVERVIEW

Professor Busse began the meeting with a brief overview of the history of operations research (OR) in healthcare in Germany. Although Germany pioneered public health a century or more ago, he indicated that most activity stopped during the Nazi and postwar period of German partition. Beginning in the late 1980s there was an effort at the Federal level to provide targeted funds to establish a series of centers based on the Johns Hopkins model of schools of public health. Three centers were established at Bielefeld, Hanover and Berlin, joined later by Düsseldorf, Munich and Dresden. The total level of funding was in the range of €50 million over 10 years. Each center developed its own research focus, but health service research did not emerge as an emphasis at any of them until the second round of funding in the 1990s.

Unfortunately, funding for these federal centers mostly ended around 2002. At the same time, however, other parts of academia began to take an interest in healthcare delivery, especially in the management community at Cologne. New degree programs have also begun to be created at the universities of applied science as a result of the European Union Bologna plan to reformat higher education on a BS, MS, PhD model similar to the United States. Prior to that time, master's programs were quite rare in continental Europe.

Professor Busse continued by describing current funding opportunities in Germany. Funding from the European Commission is available under the 6th Framework Program (mechanism to fund and promote research) according to seven thematic priorities (e.g. genomic, IT, nano, food quality and safety, aeronautics, sustainable development, citizens and governance in knowledge-based society). Professor Busse was aware of one award related to health services on the subject of "costing of individual services across the EU; i.e. how to reimburse services across borders."

Funding from the German Research Council (DFG) is difficult to obtain, because granting councils are discipline specific and there is a question as to which council will support healthcare service research. The DFG does provide funding for PhD students in the range of 10 to 20 students per year. Currently this includes one student in healthcare service research. In the past DFG provided funding for eight scholarships plus the cost of running the program. However, after the initial three-year review the program was stopped because the research focus was too diverse. Professor Busse stated that the DFG does not have an operations research component.

As to other sources of money available to fund health service research, Professor Busse mentioned the sickness funds and the various ministries such as Health and Social Affairs, which funds the Health Technology Assessment Center. He went on to explain that such funds are politically and practically oriented and tend to support decision-making processes.

At this point, Professor Rauner gave an overview of the development of operations research in healthcare service research, and general activities and funding in healthcare service research in Austria. According to Rauner, the original work of healthcare service research came out of medical schools, where the focus was

on 'social health.' This had some obvious connections with informatics and hence a connection to engineering schools.

Dr Rauner traced the development of Austrian research on healthcare logistics in the late 1970s and 1980s to the influence of German Professor Meyer at the University of Nürnberg. Meyer is now retired, but his research assistant Dr. Heidenberger, now the chair of Innovation and Technology Management at the University of Vienna, has re-established the work in Vienna. Growing out of a production systems point of view, it involves simulation and optimization work on disease management. At the University of Vienna two courses are now offered: Innovative Technology Management in Healthcare and OR in Healthcare. Both courses are offered at the undergraduate level. Rauner explained that the applied science universities in Austria offer courses in operations research but do little research. Currently Professor Rauner and her colleagues specialize in simulation and optimization for disease management. At this time they have a few MS-level students and, like other European countries, are completing the move to a BS, MS, and PhD education track.

More generally, the Austrian Academy of Science is active in health technology assessment. In this area the Academy has conducted a number of seminars and has collaborated with health technology assessment groups in Europe and throughout the world. The Institute for Advanced Studies in Vienna focuses on health economics and contributes to the Organisation for Economic Co-operation and Development (OECD) reports as well to as the European Observatory studies. The Austrian Federal Institute for Healthcare mainly produces qualitative studies.

Professor Rauner was then asked where research was conducted. She responded that most researchers have come to healthcare from production and logistic backgrounds, and that this is done typically later in their careers. Researchers work in a variety of areas, including the application of control theory to drug usage, process management, and Data Envelope Analysis (DEA) models applications to healthcare funds. At the University Vienna the focus is on strategic planning and optimization, and most recently, scheduling. Professor Richard Hartl concentrates on optimal routing strategies of ambulances for the Austrian Red Cross. At the Vienna University of Technology, Professor Gustav Feichtinger performs research in the field of optimal drug control. (<http://www.eos.tuwien.ac.at/OR/>)

In the past Professor Rauner has worked with Margaret Brandeau of Stanford University on AIDS policy, with Sally Brailsford of the University of Southampton and Steffen Flessa of the University of Applied Sciences Nürnberg on vertical transmission of disease, with Ruth Davies of the University of Warwick on coronary heart disease, with Liam O'Neill of Cornell University on benchmarking of general practitioners (GPs), on hepatitis-C transmission and prevention strategies, and nurse scheduling. She has also worked with Kevin Leonard of the University of Toronto to conduct studies of the healthcare financing system in Austria and Canada and has written on the impact of Diagnosis Related Grouping (DRG)-type of reimbursement in European systems. In the future she will investigate vaccines in terms of efficacy and length of time to eradicate diseases.

Professor Rauner was then asked to comment on strategic issues for healthcare service research. According to Rauner, Austria has nine counties, each with their own independent hospital system, their own reporting structure and sickness funds. In each state the use and form of information technology varies greatly, but at least once sickness fund has a good IT system. For this reason, researchers have limited access to data. In continuing her discussion of strategic issues she outlined a number of questions that tend to be addressed by the various Ministries:

- Which funding [insurance] system is appropriate?
- How should service components be integrated?
- What is the impact of the aging population?
- What is the appropriate size of the system?
- How can affordability be maintained?

Professor Rauner was then asked to comment on the impact of operations research models. Rauner explained that there has been some success in areas, such as regional optimization models to examine such things as the opening or closing of facilities, DEA benchmarking, and disease and injury prevention. She continued by stating that, in general, the Austrian Research Funds don't recognize operations research in healthcare or the economics of healthcare. Approximately 8% of funding is given to informatics and 8% for

economics. In her opinion, operations research must carve out a niche in these granting councils. She stated that there were other funding opportunities available from agencies such as the Austrian National Bank for economics and from the European Union, as described by Professor Busse.

Professors Busse and Rauner were asked how patient flow affects the research agenda in their respective countries. Professor Busse responded by providing his vision for three levels of research.

The macro level addresses integration issues across the European Union, international healthcare policy research, and new technology research (including IT).

The mezzo level addresses institutional management. This can include:

- Defining outcomes and indicators. Here, special targeted data collection is required.
- A DEA evaluation of the efficacy of public versus private hospitals.

In Germany the breakdown of public versus private institutions is 50% public, 40% not-for-profit, and 10% for-profit. In addressing this issue, data availability is a problem. Professor Busse went on to explain that data sets are so sparse that it is impossible to determine the ownership status of an institution from a central list.

The third level is Disease Management programs from the health system's point of view. This will enable better targeted compensation, and targeted sickness funds. Professor Busse believes that this is a growing area particularly in the realm of outcomes and costs. Currently, research in this area is limited by the quality and quantity of data available, especially when it comes to longitudinal data. According to Professor Busse, the focus on disease management may provide new opportunities for new data management collection systems. He went on to say that inpatient data is getting better because of the introduction of DRGs, but ambulatory data is collected for administrative purposes only. Germany does not have a centralized data set. However Austria does, in part because there are fewer counties and sickness funds.

Professors Busse and Rauner were then asked for examples where model-based decision making has been applied. Professor Rauner responded by describing how DEA models are used to find inefficiencies and to evaluate the impact of the process on efficiency. She then went on to explain that wait lists are less of an issue in Austria than in other European countries. She believes that this is due to a number of factors, including a surplus capacity, a better capability of matching supply to demand, the change in financial structure from per diem to DRG, and the regulation on planning new facilities. Professor Rauner continued by discussing the need for model-based decision making for issues related to the organization of care for the elderly.

In Professor Busse's response to the use of model-based decision making, he returned to the importance and need for longitudinal outcome-oriented data, especially for treatment and management of chronic diseases such as diabetes and breast cancer. Longitudinal data would allow researchers to assess the effects of policy and process change on outcomes.

Professor Busse continued by stating the need for research in the area of provider quality and technology assessment; e.g. the effective application of MRI. The ultimate goal may be service catalogs which set standards for sickness funds. Germany is currently developing a joint committee to bring together sickness funds and providers. This committee will have a sub-group to evaluate technology and to spin research projects out to university-based research groups.

Professor Busse was then asked if he had any work that focused on the effectiveness of information technology. He responded that he did not, but that sickness funds and providers were interested in this area.

Professor Busse was then asked how information technology was set up in Germany. He responded that most GPs have personal computers. He went on to say that most PCs are used for billing, to access guidelines, and in very few cases, to automatically generate prescriptions. Professor Busse pointed out that the obvious next step would be to introduce an electronic patient record, perhaps through the introduction of a smartcard. Health technology assessment will be needed to evaluate hardware and software. Currently each sickness fund issues its own card.

In response to a question concerning demand and capacity planning, Professor Busse replied that this was not much of a research topic. He continued by stating that methods for calculating capacity are crude and based on regional averages from the 1990s. Hospital mix is also determined from data from the 1990s. He

went on to say that capacity might become a research issue with the move toward an integrated network of services.

In response to a question regarding interests and efforts to collaborate with departments of engineering, Professor Busse responded that the Technical University of Berlin's Medical Technology Institute and Institute for Transport and Logistics are planning to develop an undergraduate program in healthcare.

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Date Visited: November 3, 2003

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MINUTES

François Sainfort inquired if there were any other people who should be present at the meeting to round out our experience with U.K. healthcare. The consensus amongst the group was that the following people would make good additions to our list:

- Arjan Shahani (Southampton)
- Sally McLean (Belfast)
- Jackie Riley (Strathclyde)
- David Bensley (U.K. Department of Health)
- Authors of Checklist software (www.checklist.co.uk)
- Allen Baker Associates (consultants)
- Alan Brennan (Sheffield)
- David Lane (London School of Economics)
- Tillal Eldabi (Brunel)
- Steve Cropper (Keele)
- Roger Beech (Keele)
- Andre Hare (U.K. Department of Health)
- Howard Marlin (U.K. Department of Health)
- Martin Pitt (Exeter)
- Brian Dangerfield (Salford)
- Rose Baker (Salford)
- Thierry Chausalet (Westminster)
- Nathan Proudlove (University of Manchester Institute of Science and Technology (UMIST))

Introductions then took place. The National Science Foundation (NSF) team briefly introduced themselves. The U.K. group provided a brief overview of their work.

- *Steve Gallivan* (Director of the Clinical Operational Research Unit (CORU) at UCL). CORU receives funding from the Department of Health, from directed grants, and from the Medical Research Council

(MRC). CORU applies operations research (OR) to clinical management of patients (i.e. screening policies).

- *Paul Harper* (Southampton). Harper has broad interests in both disease modeling and service planning including bed capacity planning, workforce planning, cost-effectiveness models, and decision models (HIV, diabetes).
- *Sally Brailsford* (Southampton): Brailsford describes her interests as broad. These include effectiveness/efficacy of screening models (e.g. diabetes), systems-level issues (e.g. access to after-hours care), and the introduction of behavior models into technology assessment.
- *Martin Utley* (CORU at UCL): Utley works mostly on analytical approaches to capacity planning (e.g. antenatal screening) and clinical-level decision making.
- *Ruth Davies* (Warwick): Davies has recently transferred to the University of Warwick from Southampton. She has obtained funding from the Department of Health and their agents, such as the Health Technology Assessment (HTA) group for disease modeling. She does patient-level simulation modeling to evaluate screening, prevention and treatment policies.

Diwakar Gupta inquired about funding. Steven Gallivan replied that CORU gets its funding from three major sources: the Department of Health, National Institute for Clinical Evaluation (NICE), and NHS in the form of Health Technology grants.

- For the Department of Health, funding originated in 1983. Funding is long-term and is reviewed every five years. CORU does do “one-off” types of projects (e.g. recent evaluation of flu vaccine) for the Department of Health. NB: The Department of Health maintains its own OR units in London and Leeds. London group focuses on “hot” policy issues. Leeds tends to focus on capacity planning-type issues.
- The National Institute for Clinical Evaluation (NICE) is mostly comprised of economists who work in a variety of areas such as such as drug evaluation using techniques like Markov chains and decision trees. The function of NICE is to evaluate new technologies (drugs, treatments, medical devices, etc.) as they come online. NICE is primarily intended as a review board to vet proposals by firms for the use of new products. Where sponsoring agencies are not readily identifiable (i.e. surgical procedures), NICE may invite DoH to conduct research through the NHS R&D program.
- NHS Health Technology Assessment (HTA) evaluates roll-out of pressing research issues. NHS also supports two other areas of research: Service Delivery and Organisation (SDO), which manages infrastructure change, and the New & Emerging Applications of Technology (NEAT), which supports IT and OR development amongst other things. All three streams commission research at universities.
- Other Sources: Paul Harper indicated that it is possible to get funding from the Engineering & Physical Science Research Council (EPSRC). The EPSRC provide grants to individual researchers and does have a healthcare panel. EPSRC grants to individuals are small, peer-reviewed, generally for three-year projects and are difficult to get. Dr. Harper also noted that Medical Research Council (MRC) grants are available to the U.K. group, but are largely limited to physicians and are also hard to get.

Finally, it is possible that funding could come for specific projects from the budgets of Trusts.

The group noted it is generally necessary to piggyback OR projects onto clinical grants to receive funding. Martin Utley estimated that 10-20% of all projects going to granting agencies have some OR healthcare component. This fraction is increasing and it is not strictly limited to health technology assessment. Accordingly, determining the overall level of support for OR is difficult because much of it is embedded in larger grants.

Jan Twomey inquired about OR training for highly qualified personnel, specifically physicians.

Sally Brailsford indicated that no formal mechanism exists for providing OR training to physicians, except via the usual academic routes. Ruth Davies and Sally Brailsford have offered a two-day course for the OR Society, aimed largely at junior people from the Department of Health.

Ruth Davies noted that it is difficult to get employers to pay MBA-type fees for OR courses and hence the penetration of OR courses into professional programs has remained low. For example, Warwick has a Masters of Public Administration, but it has low OR content.

Steven Gallivan indicated that CORU does some undergrad teaching, but these are service courses and are not health related.

Ruth Davies indicated that Southampton provides little formal OR healthcare training, but notes that students may work on senior year undergrad projects that have a health focus.

The group estimates that approximately 20 PhD students who are active in areas related to OR in healthcare graduate annually. Total enrollment is approximately 100.

The subject of current projects was then raised by John Blake. Each of the U.K. groups responded with a brief summary of their work.

Steve Gallivan

Dr. Gallivan is presently working on a project to monitor clinical outcomes of surgery. His group is working with a diagnostic and treatment center (DTC) to develop methods for error detection and reduction. Using control charts and stochastic models, adjusted for case mix, Steve hopes to develop tools to detect low-performing centers. Furthermore they hope to identify safe surgical processes. For instance, Steve's group is looking at events preceding surgery and evaluating their effects on surgical errors (i.e. wrong materials, human factors failures). Interestingly, they are using video tape to collect data regarding the surgical process.

Dr. Gallivan is also working on a project to evaluate diagnostic and treatment centers. DTCs are centers focusing on simple, routine elective cases (i.e. hips, eyes) without co-morbidities. The idea is to reduce surgical backlogs by clearing out some of the simpler cases. Funding for this project is being provided by SDO (Service Delivery and Organisation) stream of the NHS R&D program. The study looks at both quantitative (queue lengths) and qualitative (change management) issues.

In response to questions about the workings of DTCs, Dr. Gallivan and Dr. Davies provided the following background description. There are (or will be) 48 DTCs in the U.K. Each is regionally based, though London may have several DTCs whose focus may be different from those in the remainder of the country. The centers are designed to operate at a high volume to gain economies of scale and to reduce the variability of patient flow. In less obvious terms the DTCs are being built to fence off capacity for elective cases from variability introduced by emergency patients. This has caused some interesting workforce issues to appear (e.g. bringing in doctors from Germany to do eye surgery on weekends, since U.K. surgeons are not available). However, DTCs do present interesting potential for the application of OR models. For instance, stochastic models to investigate the impact of lengths of stay (LOS) variability/reduction are a possible area for further investigation. Additionally, optimization models might be applied to DTC case mix selection, since there will be no emergency patients. (Dr. Gallivan noted, however, that there might be problems with case mix planning if the planned volume and mix of cases fails to appear.)

Funding flows to DTCs in a variety of ways. DTCs may be part of a Trust and get funding through the Trust. They may be Trusts in their own right. The Department of Health has already announced that funds will be made available to Trusts to support capital expenditures for DTCs. Funding decisions will be made through a competitive process; Trusts applying for funding may or may not be successful, depending on the strength of their proposal.

The U.K. group indicated that there is no method for matching need to DTC capacity. Furthermore, each Trust maintains its own lists and patients may be on multiple lists waiting for a consultation.

Another project of interest for the group is the new NHS Wait List Initiative (WLI). Under this program, if patients wait more than a prescribed period of time for an elective procedure, they must be offered a chance to jump to the wait list at another region. This initiative has been put in place by the Department of Health to put pressure on providers to limit the length of wait lists. Of course, there is the perverse situation that the WLI benefits low-risk patients and may ultimately be detrimental to overall quality of care.

Currently, wait lists are published and Trusts can potentially lose funds if their list is too long. However in practice no penalties are imposed for long wait times. Under the wait list initiative, patients waiting more than six months for a consultation must be offered another choice of provider. Patients can elect to stay in the current list, or they may elect to jump to another queue. The alternative queue may be maintained by another NHS Trust, by a DTC, or a private clinic. In some cases, patients may be sent for treatment to

facilities outside of the U.K. through contracted arrangements between the U.K. DoH and their continental counterparts.

At present, case management fees (i.e. the cost of running the network) have been paid for by the Department of Health; a transportation cost of about £50 per patient, on average, has been covered by the Trusts. Steve Gallivan noted that some odd situations can arise in which Trusts can act as patient donors to themselves. In London, the Wait List Initiative is called the London Patient Choice Initiative.

Dr. Gallivan also described his work in disease screening, citing research such as stochastic models for antenatal screening for Down syndrome or blood disorders. Gallivan is presently working on an assessment of Marfan's syndrome, a congenital heart condition. Untreated, patients have a life span of about 40 years. Treatment by surgery is available, but is risky, due to lifetime requirement for anti-coagulants. Dr. Gallivan's research is designed to help patients decide when they should opt for surgery.

Dr. Gallivan also has an interest in cervical cancer efficacy. Specifically, his research is designed to answer questions such as the frequency of screening, the technology to be used, and the most effective clinical management strategy to be adopted (i.e. wait versus treatment), if anomalous cells are found. Gallivan is also interested in questions surrounding cervical cancer screening in the developing world. One particular question of interest is determining when screening should take place if it is impossible to screen frequently (i.e. if only two or three screens can take place over the course of a patient's lifetime.)

Dr. Gallivan also discussed his work on asymmetric left ventricular failure. This is a condition which by definition is not visible but can be detected with a blood test. Screening is being mooted as a possibility, but the cost-effectiveness of the program has yet to be determined. Dr. Gallivan is also interested in determining at what age the screen should be implemented and identifying how accurate it needs to be to achieve cost-effectiveness. In these studies, Dr. Gallivan is employing discrete event simulation using data from literature, decision trees, and semi-Markov chains. He notes that data is an issue. Since direct data is not available, he must rely on indirect sources.

This led to further discussion of data availability, particularly as it relates to chronic disease management. Because of the long time frame involved in chronic diseases and the lack of a central data record to provide longitudinal data, it is inherently difficult to judge the quality of treatment programs. For instance, cardiac surgeons employ a variety of treatment options without the ability to determine even relatively crude metrics for effectiveness, such as one- or two-year mortality. Hospital data is deemed incomplete and sometimes inaccurate for clinical management. Since hospital data is collected for reporting purposes, its value for determining clinical outcomes is limited. Moreover, since data is often presented and reported in such a way as to shed the best possible light on the reporting Trust, comparisons across Trusts are difficult.

Ruth Davies (Warwick)

Dr. Davies started by describing the evolution of NHS. In the 1980s Thatcher implemented a Purchaser/Provider system to induce market mechanisms into NHS. (This model has since gone out of favor with the election of the Labour government in 1997.) Dr. Davies feels that managed competition led to uneven access to care. (In the U.K., GPs are private practitioners, who supply services under contract to NHS. The terms of the contract are negotiated nationally between the British Medical Association and the Department of Health). GP payments are a mix of fixed allowances, capitation fees and fees for a number of specific services. Consultants (staff doctors in hospitals) are, conversely, salaried employees of NHS. Consultant salaries are fixed annually, but senior consultants do have some flexibility to provide a proportion of their services to private patients.

Because GPs' and consultants' wages were essentially fixed, contract flows between purchasers and providers were largely based on weighted volume. These arrangements lead to an imbalance in service across the country. Furthermore, any hospital actually failing due to mismanagement got bailed out, anyway. This has limited the incentive for hospitals to act in an economically prudent fashion. The purchaser and provider split largely disappeared under the Labour Government.

On the GP side, recent changes have led to an evolution from single or small practice into larger primary care networks. This has not, Dr. Davies feels, always been beneficial for patient care. Furthermore, Trusts, which were supposed to be a local decision-making body, often lack sufficient expertise and planning abilities.

Paul Harper agreed, and argued that there is a need to move planning tools into the hands of planners (i.e. the Checklist tool, which is useful for evaluating large-scale wait list problems). Dr. Harper argued that, at present, incredibly crude tools are used to do strategic planning and set appropriate capacity. In the realm of IT, a great deal of work remains to be done. Paul Harper noted that there is great variability in IT systems across different organizations within NHS. This leads to a situation where there is a lot of data, but little information. GP notes are less of a problem in the U.K., since paper-based notes follow patients when they move from physician to physician. (Patients are required to register with a GP when they change providers. A new GP can thus request notes from the patient's former GP). Paul noted that while GPs may have electronic record systems in their practices, the lack of compatible systems prevents the transfer of electronic records. Hospital records, similarly, remain separate and disjointed from one another and from GPs.

This discussion led the NSF group to inquire about IT initiatives in general, and the electronic patient record (EPR) in specific.

The EPR is a big initiative in NHS. A system is currently under development with a release date scheduled for 2005. However, whether the system will be operational by that date is the subject of some debate. Sally Brailsford has been doing some work for the U.K. Armed Services to build an EPR. Since this system will have to interface with NHS, there is some indication it may serve as a prototype model for an EPR.

Steve Gallivan noted there has been a history of spending on IT in the U.K. without full technology assessment. Some IT projects have ultimately proven to be less effective than was otherwise hoped for. For example, a telemedicine system was installed to support women's health services in Deptford, which received no phone calls.

Ruth Davies continued her summary of her research interests. These include the assessment of chronic diseases and screening options, primarily using discrete event simulation (DES) to follow activities of patients over time (e.g. end-stage renal failure).

Ruth Davies also applies DES methodology to disease screening (e.g. diabetes, H. Pylori). She has done extensive work in coronary heart disease. In these studies Dr. Davies is looking at a variety of issues including the impact of increased revascularization and/or decreased ambulance times on patient outcomes. Funding for the coronary heart disease study comes from the Department of Health. Dr. Davies argues that in prevention, we are treating health patients. This is something of a radical departure.

Ruth Davies concluded with the comment that even for end-stage renal disease, for which clear definitions and treatment protocols exist, latent demand is an issue; as capacity expands so too do treatment parameters.

Paul Harper (Southampton)

Paul Harper describes his work in health services research as varied. He works in capacity planning models, systems models, LOS/case mix data. He has also been active in hospital planning (i.e. impact of private funding) and scheduling outpatients (i.e. what is required to meet the patient charter).

Dr. Harper is currently interested in workforce planning. He hopes to determine the staff required for hospitals, Trusts, and regions to meet demand for the next 10 years. At present, only crude ratios are used. Harper believes in developing better tools, including dependency grids that will feed data into training requirements for doctors, nurses, etc.

Dr. Harper notes that the Department of Health does have a systems dynamics model to do workforce planning. He is also interested in doing ICU workforce planning on a regional level.

Sally Brailsford (Southampton)

Sally Brailsford describes her work as similar to Ruth Davies'. Sally builds technology assessment models that follow the individual in disease transmission, treatment, etc. (e.g. vertical transmission of HIV in sub-Saharan Africa via breast feeding).

Sally Brailsford has also used systems dynamics models to investigate the flow of patients in the emergency department of a Nottingham hospital. The model was used to test the impact of different unit configurations on patient service, including the effectiveness and efficiency of walk-in centers.

Diwakar Gupta asked Sally how demand is estimated in her models. Dr. Brailsford noted that demand estimation is a difficult task; there are some potentially serious behavioral aspects to healthcare demand that defy simple models. For example, cuts to the wait list for magnetic resonance imaging (MRI) tend to release latent demand. Accordingly, Sally argues for a qualitative approach during model building, combined with sensitivity analysis, post fact.

Martin Utley (CORU at UCL)

Martin Utley described his primary interest as technology assessment as applied to chronic disease management. In particular, Martin is interested in answering questions related to appropriateness of care. In these studies, he has moved from strict technology assessment to expert panels, since this is a more appropriate data source. Utley has completed several exercises in the area and is looking for insight/algorithms to apply to broad patient populations.

Dr. Utley also described his work in epidemiology/population health. He is developing models to determine the health impact of capital spending (e.g. including health assessment into environmental assessment.)

In terms of IT, Dr. Utley hopes to be in on a project to develop an EPR for blood analysis. He has also evaluated the use of a web management tool to make service recommendations to community pharmacies.

François Sainfort then asked the group to speculate on what could be done to improve NHS.

Ruth Davies argues that the system is subject to constant change in trying to make improvements. This sometimes eliminates good things. As a result, workforce morale and dedication have decreased, largely because of irrelevant paper work, requirements to supply useless information, and the eroding quality of the workforce. As an example, Ruth Davies feels that doctors now appear to be much more interested in money rather than giving selflessly to help the system.

Steve Gallivan argues that a lot of effort is now spent on spin. Gallivan would like to see a systems model in place. Every time a new policy is planned, it could be tested with this model. For example, the impact of European working rules (under which residents will be required to work no more than 55 hours per week) is a policy that is likely to have a significant impact that was never fully planned for.

Ruth Davies thinks enhancing GP services is necessary to improve NHS. Currently, the system includes incentives to pass along patients to consultants. This is detrimental to both cost and quality of care. Dr. Davies feels the system could be enhanced by instituting a fee for service payments for GPs.

Martin Utley indicated that it is important for NHS to decide what it is all about. Consumerism is increasing in the U.K. and is having an impact on healthcare as patients demand more choice. This increases cost, but does nothing to increase funding. Utley feels there has to be some acceptance that NHS cannot do everything. At present, NHS is more of a wish list than a plan.

Sally Brailsford, like Steve Gallivan, argues for OR models to evaluate impact of policy change at the strategic level. She believes that the system can only be planned appropriately if a systems view is taken. At present, current policies are very political and are not subject to much analysis. Brailsford believes an integrated model for policy evaluation is within the realm of possibility and points out that similar models exist in the areas of Treasury and Transport.

Ruth Davies added a note of caution, indicating that very large models are subject to error, since they do not always include behavioral aspects of individuals.

The NSF group asked the U.K. group to comment on how the research agenda is set.

A general discussion indicated that there is some mix of curiosity-driven and sponsored research. Approximately 10% of the research agenda is investigator-driven, with the remainder coming from sponsors.

Priority lists are announced by the DoH and, to a lesser extent by NHS. Most of the priorities are politically motivated. The U.K. group had mixed opinions concerning the appropriateness of politically driven research. Most felt the role of government included the right to set priorities; if such priorities are to be in place then evidence-based research is appropriate. However, when new policies and priorities are announced, researchers have to scramble to adjust their research agendas to fit the new mandates.

Steve Gallivan indicated that CORU is sometimes consulted as part of the research priority-setting process.

APPENDIX C. GLOSSARY

6th Framework Program	From the EU, a mechanism to fund and promote research
ANAES	National Agency for Accreditation and Evaluation of Health and Healthcare (France)
Benefits catalogue	A pre-specified list of diagnoses/treatments paid for by the universal health care system
BPR	Business Process Reengineering
CDC	Centers for Disease Control and Prevention (U.S.)
CDM	Chronic Disease Management (U.K.)
CEA	Cost-effectiveness analysis
CNRS	National Center for Scientific Research (France)
CORU	Clinical operations research Unit
DEA	Data Envelope Analysis
DES	Discrete Event Simulation
DFG	German Research Council (Germany)
DoH	Department of Health (U.K.)
DRG	Diagnosis Related Grouping
DTCs	Diagnostic and Treatment Centers
ECCH	European Case Clearing House
EHR	Electronic Health Record
EPA	Environmental Protection Agency (U.S.)
EPR	Electronic patient record
EPSRC	Engineering & Physical Science Research Council (U.K.)
EU	European Union
FIFO	First-in first-out
FTE	Full-time equivalent
GIS	Geographic Information Systems
GP	General practitioner
HAs	Health Authorities
HCFA	Healthcare Financing Administration
HMI	Healthcare Management Institute
HTA	Health Technology Assessment
ICU	Intensive Care Unit
IMTA	Institute for Medical Technology Assessment (Netherlands)
Improvement Leaders' Guides	Documents that outline solutions to common operational issues
INSERM	National Institute for Health and Medical Research (France)
IT	Information Technology
LOS	Lengths of stay
LSE	London School of Economics (U.K.)

MoD	Ministry of Defence (U.K.)
MRI	Magnetic resonance imaging
NEAT	New & Emerging Applications of Technology
NICE	National Institute for Clinical Excellence (U.K.)
NIH	National Institutes of Health (U.S.)
NHS	National Health Service (U.K.)
OECD	Organisation for Economic Co-operation and Development
OM	Operations Management
OR	Operations Research
ORAHs	Operations Research Applications in Health Services
PACS	Picture Archiving and Communication Systems
PCGs	Primary Care Groups (U.K.)
PCTs	Primary Care Trusts (U.K.)
RCTs	Randomized Clinical (or Control) Trials
ROC	Receiver Operating Characteristic
ScHARR	Sheffield group (U.K.)
SDO	Service Delivery and Organisation
Sickness Funds	Government-chartered non-profit corporations that serve the same function as private insurance companies in the U.S.
TQM	Total quality management
Trusts	Hospitals in the U.K. are managed by independent not-for-profit agencies called Trusts
UCL	University College London (U.K.)
UMIST	University of Manchester Institute of Science and Technology (U.K.)
WHO	World Health Organization

Appendix A: Research Supporting Key Elements of the Standards. Glossary of Key Terms. Common Core State Standards for english language arts & literacy in history/social studies, science, and technical subjects. Reading. One of the key requirements of the Common Core State Standards for Reading is that all students must be able to comprehend texts of steadily increasing complexity as they progress through school.Â appendix A |. 4. Common Core State Standards for english language arts & literacy in history/social studies, science, and technical subjects. The Standards presume that all three elements will come into play when text complexity and appropriateness are determined. Appendix G: panel biographies. Governance Advisory Panel. Chair. Professor Sadie Morgan, dRMM Architects. Vice chair. Tony Burton, community and.Â He advised HS2 Ltd on establishing the Independent Design Panel and is advising both the National Infrastructure Commission and on the Council of the National Infrastructure Planning Association. In 2010 he founded Civic Voice - the national charity for the civic movement. Tony was recognised with a CBE in 2012 for services to planning, local government and community. Annie Coombs. Deputy chair, Landscape consultant.