Prevention and Health Promotion in the 21st Century: Planning for Scarce Resources

ORAHS 2001

27th meeting of the
EURO Working Group
Operational Research Applied to Health Services

University of Vienna, Austria,
July 30th to August 3rd, 2001

Printed by Bank Austria

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Thanks are due to Nikolaus Bajmoczy, Alexander Rauner, Gerlinde Rauner, Willibald Rauner, Hildegard Roth for their assistance in organising this conference.

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Bank Austria We are grateful to Bank Austria for sponsoring our company account for this conference and for printing this book of abstracts.

DAS ZUKUNFTSMINISTERIUM bm:bwk We acknowledge the partial support of copying, printing, mailing, and staff costs for this conference provided by the Federal Ministry of Education, Science, and Culture.

ÖSTERREICHISCHES ROTES KREUZ WIEN Thanks a lot for providing us with folders and memo pads as well as for borrowing the thermos container!

Vienna Convention Bureau Thanks are due to Vienna Convention Bureau for the touristic information material on Vienna and for the conference bags.

Contents

Information on ORAHS – EURO Working Group

The **EURO Working Group on Operational Research Applied to Health Services** was formed in 1975 as part of a programme for developing special interest groups within the European branch, EURO of the International Federation of Operational research Societies, IFORS. The group has at present 112 members from 22 countries, mainly in Europe but also with 17 from overseas. The group meets every year, each summer, for one week in a different European host country. Meetings are open to anyone with a quantitative background and an interest in the subject area, although numbers may be restricted to ensure that open debate is practicable. The objectives of the group are communication of ideas, knowledge and experience concerning the application of OR approaches and methods to problems in the health services area, mutual assistance between members, co-operation on joint projects, inspiration with regard to approaches and attitudes in the field of applied Operational Research.

Information on the Meeting

We meet in the following location:

University of Vienna, Austria
Sitzungssaal (meeting room) - behind the statue of emperor Franz Josef II (main entrance, left hand side, upper floor)
Dr.-Karl-Lueger Ring 1
A-1010 Vienna, Austria

30 papers were accepted for presentation when this publication went to press. Full papers presented soon after the conference will be considered for publication after a review process in a book, thus continuing the series started with the 21st meeting in Maastricht 1995. A sample format for full papers is included in this publication.

The conference includes a round table on "Prevention and Health Promotion in the 21st Century: Planning for Scarce Resources from an Austrian Point of View," on Monday, July 30th, 9.30-11.00 a.m., with the following participants:

- Dr. Jean-Paul Klein — Bundesministerium für Soziale Sicherheit und Generationen
- Dr. Hannes Schmidl — MA-L/II Gesundheitsplanung
- Prof.Dkfm.Dr. Eugen Hauke — Wiener Krankenanstaltenverbund
- Dr. Klaus Ropin — Fonds Gesundes Österreich
- Mag. Frank M. Amort — Aids Hilfe Wien
- Prof.Dr. Bernhard Schwarz — Plattform Gesundheitsökonomie

We are highly pleased to announce our keynote speaker Prof.Dr. Margaret Brandeau, Stanford University, with her paper "Improved AIDS Policy Making: A Role for OR Models," on Monday, July 30th, 11.30-12.30 a.m.

The Organising Committee takes this opportunity to wish for a successful meeting and hope that you enjoy your visit to Vienna, in particular the University.

Information to all Participants

The Organising Committee will be on hand Sunday, July 29th, 5 p.m. – 7 p.m. at the Pension Excellence, Alserstraße 21, 1080 Vienna, Austria, for registration and a welcome drink.

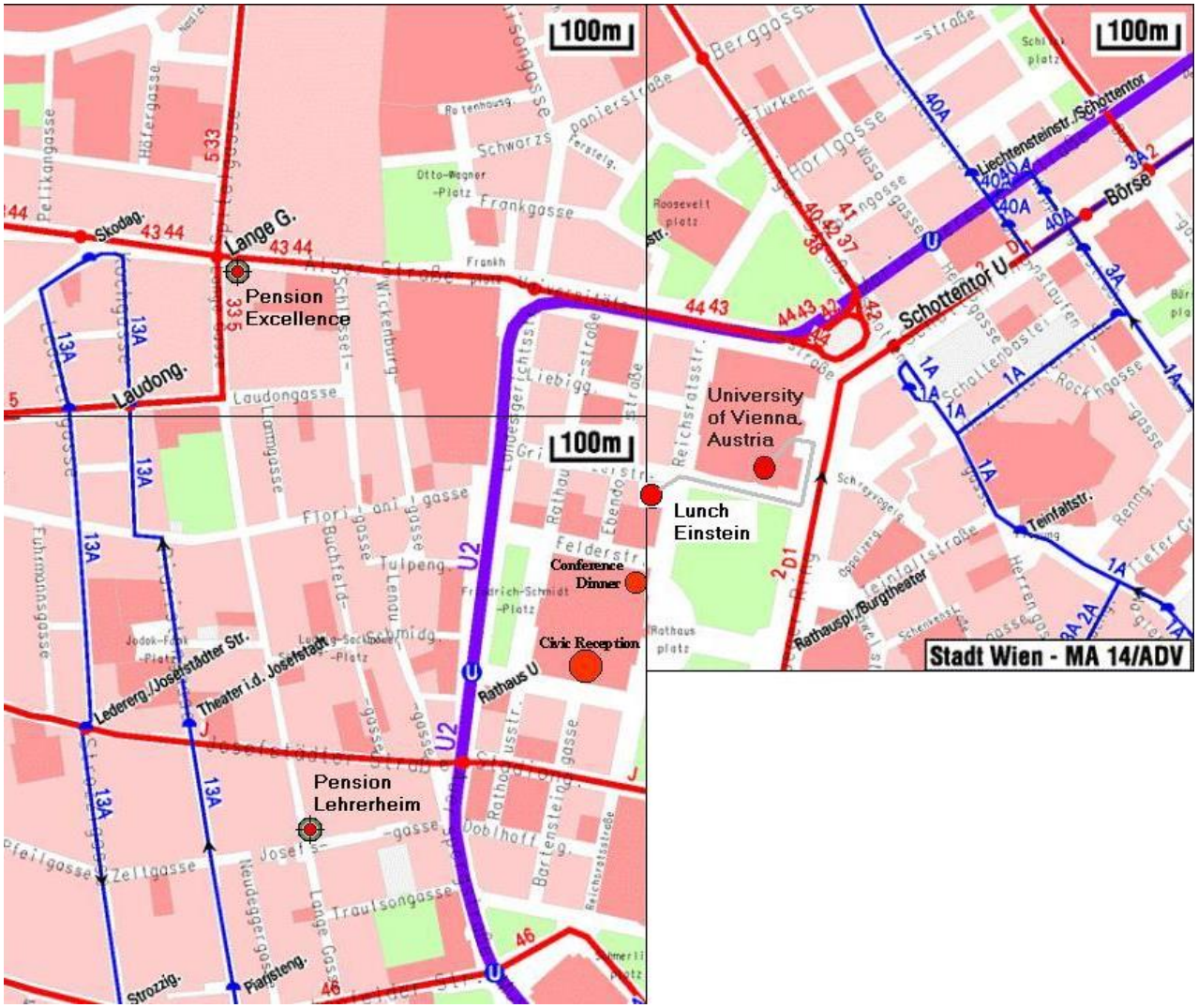
Registration fees for delegates (ATS 4,500,-) include: conference material + proceedings, reception, lunches (Einstein), coffee and tea breaks, entrance to Schönbrunn Palace, visit to the Vienna General Hospital, trip to Wachau, and the Conference Dinner (Rathauskeller).

Registration fees for accompanying persons (ATS 3,200,-) include: information material, reception, sightseeing tours in the morning, entrance to Schönbrunn Palace, visit to the Vienna General Hospital, trip to Wachau, and the Conference Dinner (Rathauskeller).

For the social events you are picked up at announced locations. Please do not forget to take all vouchers for the events with you (e.g., reception drink, lunch, conference dinner)!

Please do not forget to bring good, convenient shoes and headgear for the trip to Wachau!

In case of emergency, you can reach Marion Rauner on her mobile phone (0699 1 95 66 212).



Social Programme

Date	Delegates	Accompanying Persons
Sunday, July 29th, 2001	5 p.m. – 7 p.m. **Reception and Registration** (Pension Excellence, Bar, Alserstraße 21, 1080 Vienna, Austria)	5 p.m. – 7 p.m. **Reception and Registration** (Pension Excellence, Bar, Alserstraße 21, 1080 Vienna, Austria)
Monday, July 30th, 2001	8.30 a.m. – 9 a.m. **Registration** (University of Vienna) 9 a.m. – 9.30 a.m. **Opening session** (University of Vienna) Pickup: 6.30 p.m. Hotel Excellence 7 p.m. – 8 p.m. **Civic Reception** (Town Hall)	8.30 a.m. – 9 a.m. **Registration** (University of Vienna) 9 a.m. – 9.30 a.m. **Opening session** (University of Vienna) Pickup: 9.30 a.m. University of Vienna (Main Entrance) 9.30 a.m. – 12 a.m. **Sightseeing Tour I** KunstHausWien (+Hundertwasser House) Pickup: 6.30 p.m. Hotel Excellence 7 p.m. – 8 p.m. **Civic Reception** (Town Hall)
Tuesday, July 31st, 2001	Pickup: 5.15 p.m. Hotel Excellence 6.30 p.m. – 7.30 p.m. **Visit to Schönbrunn Palace**	Pickup: 9 a.m. University of Vienna (Main Entrance) 9 a.m. – 12 a.m. **Sightseeing Tour II** Lipizzaner Museum, Danube Area Pickup: 5.15 p.m. Hotel Excellence 6.30 p.m. – 7.30 p.m. **Visit to Schönbrunn Palace**
Wednesday, August 1st, 2001	Pickup: 8.30 p.m. Hotel Excellence 9 a.m. – 12.15 a.m. **Visit to Vienna General Hospital** Pickup: 12.15 p.m. Vienna General Hospital 12.30 a.m. – 10 p.m. **Trip to Wachau** Monastery Melk Boat trip on Danube (Melk – Spitz) Visit to Dürnstein Visit to Heurigen (Weißenkirchen)	Pickup: 8.30 p.m. Hotel Excellence 9 a.m. – 12.15 a.m. **Visit to Vienna General Hospital** Pickup: 12.15 p.m. Vienna General Hospital 12.30 a.m. – 10 p.m. **Trip to Wachau** Monastery Melk Boat trip on Danube (Melk – Spitz) Visit to Dürnstein Visit to Heurigen (Weißenkirchen)
Thursday, August 2nd, 2001	8 p.m. **Conference Dinner** (Rathauskeller)	Pickup: 9 a.m. University of Vienna (Main Entrance) 9 a.m. – 12 a.m. **Sightseeing Tour III** Treasury and City Centre 8 p.m. **Conference Dinner** (Rathauskeller)
Friday, August 3rd, 2001		Pickup: 9 a.m. University of Vienna (Main Entrance) 9 a.m. – 12 a.m. **Sightseeing Tour IV** Belvedere - Austrian Gallery

Scientific Programme, Monday, July 30th, 2001

8.30 – 9.00	**Registration**	
9.00 – 9.30	**Welcome to ORAHS 2001**	Prof.Dipl.-Ing.Dr. Günter Haring (to be invited) Dean of the School of Business, Economics, and Computer Science University of Vienna, Austria Prof.Dipl.-Ing.Dr. Udo Wagner Head of the Institute of Business Studies University of Vienna, Austria Prof.Dipl.-Ing.Dr. Richard Hartl Head of the Austrian Society of Operations Research University of Vienna, Austria
	Opening remarks	Prof.Dr. Jan Vissers Head of the EURO working group on ORAHS Eindhoven University, The Netherlands Dr. Marion Rauner Organiser of the ORAHS 2001 conference University of Vienna, Austria
9.30 – 11.00	**Round Table**	**Chair:** Dr. Marion Rauner
	Prevention and Health Promotion in the 21st Century: Planning for Scarce Resources from an Austrian Point of View	Dr. Jean-Paul Klein Bundesministerium für Soziale Sicherheit und Generationen Dr. Hannes Schmidl MA-L/II Gesundheitsplanung Prof.Dkfm.Dr. Eugen Hauke Wiener Krankenanstaltenverbund Dr. Klaus Ropin Fonds Gesundes Österreich Mag. Frank M. Amort Aids Hilfe Wien Prof.Dr. Bernhard Schwarz Plattform Gesundheitsökonomie
11.00 – 11.30	**Coffee Break**	
11.30 – 12.30	**Keynote**	**Chair:** Prof.Dr. Jan Vissers
	Improved AIDS Policy Making: a Role for OR Models	Prof.Dr. Margaret L. Brandeau Stanford University, USA
12.30 – 1.30	**Lunch**	

Scientific Programme, Monday, July 30th, 2001

1.30 – 3.00	**Health Care Management Models**	**Chair:** Dr. David Clayden
	The Nature and Content of Health Operational Research	Prof.Dr. Jan Vissers, Technical University Eindhoven, The Netherlands
	Towards Incorporating Human Behaviour in Models of Health Care Systems	Prof.Dr. Sally Brailsford, University of Southampton, United Kingdom
	Developing Preventive Services for Older People	Prof.Dr. Tom Bowen, Tom Bowen Associates, Brighton, United Kingdom

3.00 – 3.30	**Coffee Break**

3.30 – 5.00	**Decision Support Systems**	**Chair:** Prof. Dr. Sally Brailsford
	Complex decision making in hospitals: a simulation study for analysing logistic processes	Prof.Dr. Sigrun Schwarz, Fachhochschule Münster, Germany
	A Decision Support System for Assigning Personnel to Teams in Health Services	Prof.Dr. Jan A.M. Schreuder, University of Twente, The Netherlands
	Emergency Information Support System for Brazilian Public Hospitals	Prof.Dr. Mario Jorge Ferreira de Oliveira, Federal University of Rio de Janeiro, Brazil

Scientific Programme, Tuesday, July 31st, 2001

8.30 – 10.00	**Health Services Planning**	**Chair:** Prof.Dr. Harald Buhaug
	Establishing and Monitoring Outcomes in Social Care	Dr. David Clayden, David Clayden Associates, Otley, United Kingdom
	SNAC - The Swedish National Study on Ageing and Care	Dr. Marten Lagergren, Stiftelsen Stockholms läns Äldrecentrum, Sweden
	Österreichisches Bundesinstitut für Gesundheitswesen Working Field "Health Care Planning"	Dr. Michaela Moritz, Österreichisches Bundesinstitut für Gesundheitswesen, Vienna, Austria

10.00 – 10.30	**Coffee Break**

10.30 – 12.00	**Knowledge Management in Health Care**	**Chair:** Prof.Dr. Jan Schreuder
	What Elderly? What Care? The Case of Videotelephony Decision Tree: Data Mining tools and the Measurement of Non-physical Properties	Prof.Dr. Antonia Arnaert, Catholic University of Leuven, Belgium
	Process Management in the Health Care Sector	Dr. Rainer Telesko, University of Vienna, Austria
	Performance Measurement and Knowledge Management in Health Care	Prof.Dr. Lucas Delesie, Catholic University of Leuven, Belgium

12.00 – 1.00	**Lunch**

1.00 – 2.30	**Hospital Planning Models I**	**Chair:** Prof.Dr. Steve Gallivan
	Analytical Methods to Assist Hospital Planning	Prof.Dr. Martin Utley, University College London, United Kingdom
	Hospital Performance and its Trends	Prof.Dr. Martin Dlouhy, University of Economics, Prague, Czech Republic
	A Mathematical Model of Hospital Re-admissions	Prof.Dr. Harald Buhaug, SINTEF UNIMED, Trondheim, Norway

2.30 – 3.00	**Coffee Break**

3.00 – 4.00	**Prevention and Health Promotion I**	**Chair:** Prof.Dr. Ruth Davies
	Differences Between Breast Cancers Detected Through Screening and Self-detected Cancers	Prof.Dr. Valter de Senna, Federal University of Bahia, Salvador, Brazil
	Monitoring Adverse Events in Surgery	Prof.Dr. Steve Gallivan, University College London, United Kingdom

Scientific Programme, Thursday, August 2nd, 2001

9.00 – 10.30	**Prevention and Health Promotion II**	**Chair:** Prof.Dr. Margaret Brandeau
	An Age-Structured Model for Drug Control – the Optimal Mix of Prevention and Treatment	Prof.Dipl.-Ing.Dr. Richard F. Hartl, University of Vienna, Austria
	Use of Simulation in the Evaluation of Disease Prevention	Prof.Dr. Ruth Davies, University of Southampton, United Kingdom
	Cost-effectiveness of Early Defibrillation: the Case of the Austrian Red Cross	Dr. Marion Rauner, University of Vienna, Austria

10.30 – 11.00	**Coffee Break**

11.00 – 12.30	**Hospital Planning Models II**	**Chair:** Prof.Dr. Mario Jorge Ferreira de De Oliveira
	Simulation Based DSS for the Optimal Planning of a Transfusion Centre	Prof.Dr. Vanda De Angelis, University of Rome "La Sapienza," Italy
	Detailed Practical Models for Planning and Managing Hospital Capacities	Prof.Dr. Arjan Shahani, University of Southampton, United Kingdom
	A Goal Programming Approach to Strategic Resource Allocation in Acute Care Hospitals	Prof.Dr. Michael W. Carter, University of Toronto, Canada

12.30 – 1.30	**Lunch**

1.30 – 3.00	**Hospital Planning Models III**	**Chair:** Prof.Dr. Arjan Shahani
	Performance of Austrian Hospital Wards – Comparison Using Two Output Measures	Dr. Monika Riedel, Institute for Advanced Studies, Vienna, Austria
	Comparing Alternative Policies for Hospital Admission Planning	Prof.Dr. Jan Vissers, Technical University Eindhoven, The Netherlands
	Should Priorities be Quantified?	Prof. MBA Penelope M. Mullen, University of Birmingham, United Kingdom

3.00 – 3.30	**Coffee Break**

3.30 – 5.00	**Prevention and Health Promotion III**	**Chair:** Prof.Dr. John Macfarlane
	Planning for Scarce Resources - Stage 2: Returning from Health Insurance Based Internal Market towards Centrally Planned Disease Prevention under "Budgetary Insurance Mixed Finance Model"	Prof.Dr. Marek Lubicz, Technical University of Wroclaw, Poland
	Data Analysis and Modelling for the Care of Indians with Diabetes	Dr. Mehmood Sayyad, KEM Hospital and Research Centre, Rasta Peth, India
	Questionnaires, Questionnaires, Questionnaires…The Measurement of Non-physical Properties in Health Care Management	Prof.Dr. Lucas Delesie, Catholic University of Leuven, Belgium

Scientific Programme, Friday, August 3rd, 2001

9.00 – 10.30	**Session for late-registered participants***	**Chair:** to be announced
	to be announced	**to be announced**
	to be announced	**to be announced**
	to be announced	**to be announced**

*This session might be cancelled.

10.30 – 12.30	**Group Issues**	**Chair:** Prof.Dr. Jan Vissers

12.30 – 1.30	**Lunch**

Abstracts of the Presentations

All abstracts received by July 4th, 2001, are included in this book of abstracts. In the following, we list the abstracts of the presentations sorted by the last name of the presenter.

What Elderly? What Care? The Case of Videotelephony Decision Tree: Data Mining Tools and the Measurement of Non-physical Properties

Antonia Arnaert, Catholic University of Leuven, Belgium

This paper addresses the management of home care for the elderly using the video-telephone (VT). Concretely it investigates *what elderly needs what VT interventions under what conditions, and conversely, for what elderly VT interventions have no effect.*

Beside the improvement of the technical infrastructure, the management of VT care requires focus and evidence. More refined, calibrated management indicators are developed to measure and monitor the many non-physical properties (e.g., loneliness, depression…) involved: *What interventions for what types of elderly? What outcomes and health improvements can be expected? What skills do the care providers need?* These properties occur commonly in health and care management. Culture, semantics, registration procedures, knowledge, experience, insight, sensible analysis, scale construction, and logic of score algorithm… all concur in this process.

Data go through a lot of operations before they produce *knowledge that may support the decision making of managers*. *Data registration* and *warehousing* involves the entire data production process to make data available and accessible. Next to the important and necessary operation: *data cleaning*, follows *data mining*, which discovers patterns and relationships in data with different sensible data analysis tools such as (logistic) regression, cluster analysis, decision trees, neural networks… Nowadays, it is widely used by customer focused companies: e.g., retail, financial, communication, and marketing organisations. This study investigated all of these techniques to ascertain the most appropriate tool to explore what experimental conditions or independent variables had major *effect* on the variables under investigation or dependent variables. We selected for our subsequent analysis and results: the *decision tree*. An empirical decision tree represents segmentation of the data created by applying a series of rules generated by the techniques. This tool is simply an allocation rule that determines if a client belongs to a particular customer (sub-)segment or not.

This contribution will illustrate the use of *decision tree* as a sensible data mining tool within an ICT context in comparison with other tools such as *neural networks* and another more popular approach to identify groups of subjects such as *cluster analysis*.

Developing Preventive Services for Older People

Tom Bowen, Tom Bowen Associates, Brighton, United Kingdom

In the UK the Government has put some priority into the development of 'intermediate care' services for older people. These are services that can be deployed either to prevent admission to an acute hospital, or to support earlier discharge, in particular when rehabilitation is needed.

We have adapted the *Balance of Care* approach to support the identification of appropriate care strategies, and to quantify the requirements for particular skills and services, and their cost. Initially work on workforce requirements was undertaken for the UK Department of Health, and subsequently a number of locally based projects have explored the potential for alternative services in greater depth.

The care strategies being adopted are frequently innovative, and there are few available data to support decisions. For local studies we have adapted a form of Point Prevalence Survey, which surveys existing hospital populations to identify the appropriateness of the admission, and the need for continuing acute medical care, based on agreed protocols. The results of these surveys highlight the potential for significant change in the balance of care, and we have used them in detailed debate with local clinicians to develop acceptable new care strategies.

The data can also be used to populate a version of the Balance of Care model focussing only on older people who currently suffer acute events. This work has already extended beyond the specification of the services required to prevent admission and achieve earlier discharge, and is now exploring the nature of targeted screening approaches to prevent the acute events occurring in the first place.

This paper explores the elements of a preventive *Balance of Care* model, and describes findings from local and national applications.

Improved AIDS Policy Making: A Role for OR Models

Margaret Brandeau, Stanford University, USA

Although millions of dollars are spent annually on HIV prevention in the United States and other industrialised nations, resources for HIV prevention are limited. Policy makers must choose which prevention programs to fund, how much to spend on each program, and which population risk groups to target. OR models can play an important role in determining the costs and benefits of alternative HIV prevention programs – and thus can support improved AIDS policy making.

To illustrate, we describe models for three current HIV policy problems: HIV screening of pregnant women and newborns, maintenance treatment for opiate injectors, and allocation of HIV prevention funds. We show how such models can lead to insights about program cost and effectiveness that are not apparent upon inspection. We conclude with discussion of the broader role for OR models in HIV prevention and treatment planning.

Towards Incorporating Human Behaviour in Models of Health Care Systems

Sally Brailsford, University of Southampton, United Kingdom
Bernd Schmidt, University of Passau, Germany

Operational Research models are well established as an effective tool for tackling a vast range of health care problems. Many of these models involve parameters which depend on the behaviour of human beings. For example, epidemic models of the spread of HIV/AIDS depend not only on biological and physiological factors, but also on behavioural factors such as condom use, number of sexual partners, and needle-sharing. Models for the prevention and treatment of heart disease need to account for variation in smoking, exercise, and dietary habits. Models to evaluate screening programmes for the early detection of disease must include a factor for patients' compliance (the proportion of patients who attend each screen). In fact Brailsford and Davies's model for screening for diabetic retinopathy (2000) was highly sensitive to assumptions about compliance.

Research into health-related behaviour has been mainly within the discipline of psychology. The best-known models for health behaviour include Becker's Health Belief model (1974), Rogers' Protection Motivation Theory (1975), Bandura's Self-Efficacy model (1977), Ajzen's Theory of Planned Behaviour (1991) and Wallston's Health Locus of Control model (1992). The main purpose of these models is to explain rather than to predict, and moreover it is not immediately obvious how they may be "translated" into OR terminology and implemented in a practical modelling context.

Schmidt, who works in the area of agent-based simulation, has developed an alternative methodology for modelling human behaviour. Schmidt's architecture for modelling human behaviour is called PECS: Physical state, Emotion, Cognition, and Social status. These factors together explain and predict what Schmidt terms "reactive" and "deliberative" behaviour. Reactive behaviour can be determined by the application of a set of rules and is low-level (e.g., instinctive or emotional behaviour), whereas deliberative behaviour is higher-level and involves the conscious pursuit of goals.

In this paper we discuss a very simple implementation of the PECS architecture, incorporated within Brailsford and Davies's model for non-insulin dependent diabetes (NIDDM). The model does not use agents, but retains its original discrete event simulation structure, and the PECS factors are modelled chiefly as attributes of the patient entities. Various forms of the PECS equations were used and compared with the original numerical data used in the model, which was obtained from the Leicester University Diabetic Retinopathy Audit (1999) and showed compliance to be fairly high (averaging over 80%). Studies into compliance with breast cancer screening suggest that previous attendance is a good predictor for future attendance, and also that attendance is associated with higher educational and social status.

The model uses some ideas from the Health Belief model, but is essentially a feasibility study into the possibility of using the PECS architecture to model patients' attendance behaviour for screening. It provides a more sophisticated method of modelling compliance than the simple random sampling of patients used in published versions of the NIDDM screening model, but more work needs to be done on refining the methodology, and there are (inevitably) implications for using PECS in terms of the additional data required.

A Mathematical Model of Hospital Re-admissions

Harald Buhaug, SINTEF UNIMED, Trondheim, Norway
Torhild Heggestad, SINTEF UNIMED, Trondheim, Norway

During the first days or weeks following a hospital stay, some patients are readmitted to the hospital. It is common belief that quite often, re-admissions are caused by problems that were not properly dealt with during the first stay, and, therefore, can be used as indicators of inadequate care. In some utilisation review systems, readmission rates are used, among other indicators, to assess the quality and appropriateness of hospital care.

For various reasons, it is sometimes convenient to split the care of a patient up into several stages, corresponding to several hospital stays. In such cases, patients are discharged and readmitted according to plan. Planned re-admissions do not indicate inadequate care; in this paper, only unplanned re-admissions are considered.

Most hospital admissions are, of course, not re-admissions. From a statistical point of view, unplanned admissions occur more or less at random. By pure chance, it sometimes happens that individuals are hospitalised only a short time after they were discharged from a previous stay, even if there is no causal relationship between the first and the second stay. In order not to avoid erroneous judgements about quality of care, we will make a distinction between re-admissions that are causally related to the previous stay, and those that are not. The former are denoted *genuine*, and the others *spurious* re-admissions.

The length of the observation period is an important design parameter in re-admission studies. In many studies, the observation period is set to 30 days, which means that a re-admission is defined as a new admission within 30 days of discharge from a previous hospital stay by the same patient.

This study is part of a larger project on re-admissions, based on data from Norwegian hospitals. In this paper, we will use life table analysis and a mathematical model of re-admissions to analyse the potential for using re-admissions to assess hospital outcome. We will use the model to estimate the rate of genuine re-admissions, to explore the sensitivity and specificity of the readmission rate as an indicator of hospital outcome, and finally to see how this is affected by the length of the observation period.

This paper does not end up with firm conclusions as to the appropriateness of using readmission rates to indicate quality of care. It points out and discusses some of the theoretical and methodological issues that should be considered in the design of utilisation review and similar systems using readmission rates as outcome indicators.

A Goal Programming Approach to Strategic Resource Allocation in Acute Care Hospitals

John T. Blake, Dalhousie University, Canada
Michael W. Carter, University of Toronto, Canada

This paper describes a methodology for allocating resources in hospitals. The methodology uses two linear goal-programming models. One model sets case mix and volume for physicians, while holding service costs fixed; the other translates case mix decisions into a commensurate set of practice changes for physicians. The models allow decision makers to set case mix and case costs in such a way that the institution is able to break even, while preserving physician income and minimising disturbance to practice. The models also permit investigation of trade-offs between case mix and physician practice parameters. Results are presented from a decision-making scenario facing the surgical division of Toronto's Mount Sinai Hospital after the announcement of a three-year, 18% reduction in funding.

Establishing and Monitoring Outcomes in Social Care

David Clayden, David Clayden Associates, Otley,United Kingdom
Adrian Bonner, University of Kent, United Kingdom

The demand for social care is increasing. Care provided to a variety of clients with a range of needs by a complex of voluntary carers, government departments, agencies on behalf of local and national government and private care companies. There are a huge variety of types of care provided that can be mapped on the degree to which they are, for example, institutional or not, residential or not, formal or not, direct or not, medical or social.

There are demands and requirements on organisations working in this field to demonstrate to government that the care provided and the associated care interventions undertaken reach a minimum standard and result in satisfactory outcomes for the client. Agencies need to demonstrate that they provide effective care and value for money.

An action-research project between a major social services delivery agency and Kent University has led to:

- the construction of tools to provide appropriate process and outcome measures of performance
- the determination of how to implement those tools in a practical care setting, including the collection and processing of data
- the piloting of the system in the context of caring for those with drug addiction

The paper outlines the approach adopted and the technology used, and reports on progress to date and further plans.

Use of Simulation in the Evaluation of Disease Prevention

Ruth Davies, University of Southampton, United Kingdom

Health Services in Europe are faced with complex decisions about the extent to invest in preventative measures. The difficulties of evaluating prevention include the following:

- you have to treat many individuals,
- these individuals may see little benefit from the treatment and therefore, compliance may be poor;
- the interaction between prevention and treatment may be complex and may differ from one individual to another,
- rather mundane prevention work may compete for resources with apparently heroic treatments,

Discrete event simulation (DES) is a technique that can describe complex patient pathways and can provide summaries of resource use over periods of time. Resource can be costed and alternative strategies evaluated.

We should look at two contrasting examples which use a version of DES, adapted for use in the health services context, called POST (patient oriented simulation technique). This approach enabled a patient to be scheduled for more than one activity at once. This provides enormous flexibility in the way the model is formulated.

The first example is of 'one-off' screening and treatment. A large proportion of the adult population is chronically infected by the Helicobacter pylori bacteria. This infection is a major cause of peptic ulcers and gastric cancers. It may be eradicated quite cheaply per head of population but the clearly the costs accumulate. Simulation makes is possible to look at first time ulcers, repeat ulcers and cancers in the same or different individuals and to look at a range of screening scenarios. The most sensitive parameters turn out to be, however, the discount rates for costs and benefit.

The prevention of coronary heart disease (CHD) is much more complex. Identified 'at risk' individuals must take drugs, which may have side effects, for the rest of their lives. The Southampton group concentrated on secondary prevention, prevention therapies provided to people with symptoms of coronary heart disease. Initial results show that this may be much more beneficial in preventing further disease and saving life than more dramatic interventions such as coronary artery bypass surgery. We have not yet, however, factored in the prevention of pain and the quality of life, which may change the balance in the evaluation of cost effectiveness.

Computer are increasingly powerful and can describe the progress of large numbers of individuals though the simulations may appear to be frustratingly slow, particularly where we a looking for significant differences between small outcomes. Despite the availability of good graphic driven 'of the shelf' simulation software, we use Pascal with a Delphi interface in order to provide flexibility and, in particular, to use the facilities of POST. We are dependent on the availability of good data but these are not always available and assumptions have to be made and tested. Cost data are particularly important and very variable. Despite these drawbacks, simulation provides information that can not be made available in any other way.

Simulation Based DSS for the Optimal Planning of a Transfusion Centre

Vanda De Angelis, University of Rome "La Sapienza," Italy
Giovanni Felici, Institute of Systems Analysis and Computer Science of the National Research Council, Rome, Italy
Paolo Impelluso, University of Rome "La Sapienza," Italy

The Transfusion Centre (TC) of the Policlinico Umberto Primo hospital of the University of Rome "La Sapienza" is supported by the Ad Spem donors' organisation that monitors donors' behaviour and periodically invites them to dislocate to the TC to donate blood. Ad Spem cares very much about offering a good organisation of the services so that donors may be promptly received and waste as little time as possible in the TC. This work aims at supplying the TC managers with a DSS based on simulation that may help them in detecting bottlenecks in the organisation and in taking decisions to improve it.

The complete process consists of five different phases: registration, haemoglobin test, medical visit, donation, and recovery. In each phase the number of personnel units that provide the service may vary within certain ranges, and can be selected amongst doctors, nurses, and other employees according to the phase.

Information on the TC production process, from the arrival of a donor to his/her departure, were collected from the staff. Additional information were collected from donors, by asking them to fill a questionnaire which contained quantitative questions about service and waiting times in the various phases of the production process, and qualitative questions about their degree of satisfaction in relation to the various phases of the system.

Probability distributions of the inter-arrival and service times have been estimated and used in the construction of a simulation model that has been run several times to evaluate the efficiency of the TC under different service policies and different size and composition of the staff, providing useful insights in the system to the TC managers.

The inter-arrival time of the donors at the centre is generated according to a negative exponential distribution, the while service times of the different phases are generated from lognormal distributions. The simulation model has been implemented in Visual Basic with a friendly graphical interface that, beside producing quantitative measures and indicators of the system performance, provides the user with a visual representation of the donation process.

Using the simulation model a large number of scenarios have been simulated, by varying the arrival rate, the parameters of the service time distributions, and the number of personnel units allocated to each phase of the donation process; the main performance indicators are the average time in system and the average time in queue, that identify the quality of service provided to the donors. The simulated scenarios have then been used, together with the cost figures of the different types of resources, to identify the minimum cost TC configurations for as given quality of service and the best quality of service that can be provided with a constraints on the total TC cost.

The complete simulation system has then been designed as a DSS that can support the TC managers in making decisions regarding the configuration of the service, the strategies to interact with the donors, and the scheduling of the TC staff.

Performance Measurement and Knowledge Management in Health Care

Lucas Delesie, Catholic University of Leuven, Belgium

The quality of medical care not only demands for conceptual frameworks, woolly recommendations but also for real-life monitoring. Much medical data already resides in databanks. These databanks raise questions about privacy and standards. Technological progress also demands for continuous datawarehousing.

Once the data are available, they run the risk of simplistic interpretation. Policy-makers, managers, insurers want to simplify things. Millions of patients and interventions are classified in a limited number of types. Aggregation is limited to counts, sums and averages of interventions or costs. These aggregations cover up all fine shades that were recorded.

This contribution investigates knowledge discovery and insight with respect to performance measurement. We look at the gap between analysis and synthesis: multiple criteria decision making, data envelopment analysis. We will argue for new data visualisation methods to bridge the gap. We illustrate this contribution with the case of one hospital: its medical activity centres and their performance indicators.

Questionnaires, Questionnaires, Questionnaires… The Measurement of Non-physical Properties in Health Care Management

Lucas Delesie, Catholic University of Leuven, Belgium

Measurement is the first step towards knowledge discovery. Enterprises, companies, agencies depend on measurement for their decision-making and management. Basically, measurement produces numbers to figure out where we stand and allow us to make decisions to move forward. But numbers have no meaning at all and their sense completely depends on our knowledge, insight, experience and logic. Informatics and computers now allow everybody to collect data on any type of questionnaire and to execute any set of operations on any volume of numbers with no trouble at all. The meaning and interpretation of the final property scores is often exotic. Many operations and interpretations are based on assumptions and simplifications or are even plain illogical. They are yet hardly mentioned and many authors are not even aware of them.

The distinction between research and management measurement is crucial. Researchers aim at general conclusions for large populations. They run experiments and actively control their data to safeguard general applicability. Their data is clean, static and relatively small. They test hypotheses. The goal of management is business: daily, ever-changing, or strategic, long range, business. Management relies on operational data: dynamic, voluminous, dirty data that change continuously. Cost and time considerations force them to observe passively rather than under controlled circumstances and by external controllers. As a result, management hires staff and uses tools to aggregate its data into information to strengthen its management decisions. This information is called "management information systems", "management indicators", "hard facts, evidence", "performance indicators", "balanced score cards". Management indicators pilot the operational units, the individual professionals and staff members towards the most appropriate "interventions" (WHO, 2000) for any particular patient at any particular time during his therapy. The management goal is customisation: the opposite of "large populations" and its simplifying "law of large numbers".

Non-physical measurement and assessment scales are very common in health care management: severity, risk, intensity, competence, performance, staff motivation and evaluation, patient preferences, autonomy, satisfaction… Divergent subjective feelings, personal experiences and opinions are at play. Culture, semantics, registration procedures, knowledge, experience, insight, sensible analysis, scale construction and logic of score algorithms… all concur in the measurement process. A simple verbal translation of some imported questionnaire developed for research purposes is insufficient. A simple addition of the item scores may be valid for large populations but can easily becomes useless for customer segments, individual professionals or staff teams. The central issues are *how can we develop pinpointed management instruments? How can we pilot and reach scale consensus among the stakeholders? How can we arrive at valid and reliable information or 'evidence' to strengthen this consensus?*

My contribution will introduce the main issues by way of an example. Gauging involves the delineation of (sub-)concepts and their operationalisation into properties, items and response choices in tune with the culture, experiences, understanding, motivation and semantics of the stakeholders in the domain. Calibration involves the data mining, data analysis, statistics, and algorithms to arrive at valid and reliable information, knowledge and management indexes.

Differences Between Breast Cancers Detected Through Screening and Self-detected Cancers

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Breast cancer has been for many years a major cause of concern in Western countries. It has an enormous impact on the individual as it frequently strikes in the prime of life. When it is fatal, it is often after a prolonged, painful and disabling period of disease. In England and Wales, 1 in 11 women will develop breast cancer in her lifetime. It accounts for about 5% of all female deaths and about 20% of female deaths associated with cancer.

The NHS Breast Screening Programme in England, whereby women aged 50 to 65 are given 3 year interval mammography, runs at more than £30 million per year and has recently been the subject of a lot of controversy regarding its likely benefits. The logic behind breast cancer screening is that if the cancer can be detected in the pre-invasive stage, before any spread has occurred, the correct treatment is likely to be much more effective. The most common method of attempting to evaluate the outcome of screening has been to compare survival of screen detected cases with the survival of cases diagnosed because of the awareness of symptoms, without screening.

Patients whose disease is detected by screening are diagnosed earlier than the time that clinical diagnosis through self-awareness would have occurred. Even if the time of death is unaltered, the proportion of cases that survive a given period after diagnosis will increase as a result of earlier diagnosis alone. Therefore, to develop adequate models of a screening programme, it is important to evaluate ***lead time***, that is how long has the screening programme advanced the diagnosis. This lead time is then deduced from the patient's survival time, to find how much screening has benefited survival. Hence, an important part of this evaluation is the determination of how fast the tumour is growing, the tumour doubling time.

We feel that ***length bias*** in screening has not been properly accounted for in the models that currently propose to quantify the benefits of a breast cancer screening programme. Length bias arises because the screening procedure is more likely to detect cancers with a longer duration of pre-clinical disease.

In this paper we examine the likely size of this sampling bias for the present UK breast cancer screening programme and for some alternatives under consideration.

Hospital Performance and its Trends

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There is a growing pressure towards more efficiency in the public sector, especially in the health care system. In this study, the performance/productivity of hospitals from the Region of West Bohemia is evaluated. We use data from years 1996 - 1999.

Two authors use two methods of analysis: regression-based best practice production functions and data envelopment analysis. A best practice production function is found as a nearest approximation of relevant frontier production function. Technical efficiency is then measured by a ratio of current output to the feasible technological maximum given by the frontier.

Data envelopment analysis is a non-parametric method, used for performance measurement and benchmarking. It is based on the theory of linear programming, it uses quantities of inputs consumed and outputs produced to calculate the relative technical efficiency of decision-making unit.

The possibilities of potential savings were found in the operation of hospitals by both methods. We found a decreasing trend in hospital performance during the observed period with a possible stabilisation in the last year. One of the likely explanation is the change of the reimbursement mechanism in July 1997.

Emergency Information Support System for Brazilian Public Hospitals

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Lupe N. Pizan Toscano, Federal University of Rio de Janeiro, Brazil

A medical incident usually generates a hospital emergency case which normally requires hospital attention, and activates a chain of events inside the institutions which provide specialised care the community. This fact requires that a series of decisions have to be taken by the different entities involved in the rescue and treatment of the victim(s). The response time in providing the care is very important and, in many instances, means the difference between the life and the death.

The public attention to the emergency cases in the city of Rio de Janeiro is usually made in two stages, The Pre-Hospital and The Hospital care. The objective of this paper is to propose a suitable Emergency Information Support System for the public emergency care in the city. Visual Simulation Models is used to study It aims at evaluating the present system, the balance between demand and supply of services, providing Visual Simulation models to improve the utilisation of the available human and material resources. It is argued that the integration of these two stages improves the quality of the services provided.

Monitoring Adverse Events in Surgery

Steve Gallivan, University College London, United Kingdom

In 1994, Marc de Leval and colleagues first introduced surgeons to the notion of monitoring outcome for a sequence of operations to detect divergent performance. The ideas introduced, particularly the use of 'Cusum charts', have since been applied in adult cardiac surgery. Various modifications to these cusum analysis methods have been devised to allow case mix and consequent heterogeneous risk to be taken into account. One of these methods, which goes by name VLAD, is now in routine use in many hospitals for monitoring outcomes in adult cardiac surgery.

Surgeons regard case mix correction as extremely important ingredient in evaluation of performance and thus methods like VLAD are being accepted as audit tools. However, there are circumstances where it is by no means easy to apply such methods. Paediatric cardiac surgery is one such example. Here, surgeons perform many different type of operation, most relatively infrequently. There is also a dearth of systematic data upon which to base risk estimates and, in any case, mortality rates appear to be falling for some procedures. The talk will discuss the potential for using VLAD-like methods, and other analysis techniques, to help in the identification of suspicious runs of divergent performance that can be further investigated by other audit methods.

An Age-Structured Model for Drug Control – the Optimal Mix of Prevention and Treatment

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Richard F. Hartl, University of Vienna, Austria
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This paper contains some general age structured model for drug dynamics and violence control and studies the OSSP for the autonomous problem. It turns out that different solutions arise, where an unstable equilibrium and also a saddle point equilibrium can occur in the interior. The origin is always a saddle point equilibrium.

In that particular case also a Skiba point exists. This implies that for a small number of drug users saddle point convergence occurs, while if the number of drug users is large the effect of prevention is too low (due to a too the smaller reference group of non-users) to warrant large prevention expenditures. Also, in this case treatment expenditures are expensive so the amount of optimal treatment will be low too.

SNAC - The Swedish National Study on Ageing and Care

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As part of the Swedish Governmental Action Plan for the Elderly a large longitudinal study on ageing and care was started in Sweden in 2001. The purpose of "The Swedish National Study on Ageing and Care" (SNAC) is to establish longitudinal databases composed of data, that describe the development of ageing and the needs for care of the elderly and how these needs are met by the public care system and the informal system of care. The study is partly financed by the government and partly by the participating municipalities and county councils. The study is planned to go on for many years, making it possible to follow the ageing of persons from the age of 60 and onwards.

The SNAC-study builds upon the joining of two perspectives: the population perspective and the care system perspective. The data collection takes place in four different participating areas following a common design and according to a common core protocol. In the following will be described the care system part. The purpose of this part of the study is to continuously record on an individual basis all care services provided for the elderly living in the area by the municipality and the county council - acute as well as long-term. The collected data will be used as basis for planning, resource allocation and evaluation of the care services. Another purpose is to provide data for research and development in the area of elderly care. An important aspect of the project design is the possibility to connect the data concerning different aspects of ageing and the development of needs of care services, which are collected in the population part, with the data concerning provided care services from the care system part. This will among others give the opportunity to compare those elderly that receive public services with those that do not.

The care system data collection began with a baseline survey covering all persons 65 years and above, who lived in the area and received public long-term care on February 1, 2001. After that continuous recording takes place of each (substantial) change in the provision of public care and services for all persons over 65 years.

The data collection is made according to a protocol that is essentially the same for all four participating areas. Each record will contain some personal circumstances (age, sex, marital status) and further state the amount and kind of granted social and medical services, rehabilitation and aids. Registration is also made concerning dependency and different environmental factors, that potentially influence the care services decision, such as living circumstances and access to informal care. Further the need for special nursing services are registered. The common protocol makes it possible to make different kinds of comparisons between the four participating areas. Registration in the social services is made by the ordinary staff complemented by project staff. Certain items are taken from the ordinary administrative registration systems in the municipality and the county council. Joining these data requires the consent from the participating registered persons.

Planning for Scarce Resources – Stage 2: Returning from Health Insurance Based Internal Market towards Centrally Planned Disease Prevention under "Budgetary Insurance Mixed Finance Model"

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Starting from the overall theme of the meeting, namely: concepts and processes for Prevention and Health Promotion, performed by particular entities of the health care sector in the Lower Silesian Region of Poland, the considerations are directed towards general picture of the sector in contemporary Poland. The composition of Health Insurance concepts and Internal Market mechanisms, introduced by the Nation-wide Health Insurance Act of 1999 as a means aimed at increasing economic and managerial efficiency, and - at the same time – also aimed at improving medical effectiveness and patient acceptance, is briefly described in comparison with other health financing models in Poland and Europe.

Models and systems, autonomously developed in Lower Silesian Sick Fund (and its Contracting Strategy Department), supported by leading European concepts (DRG, GPFH, LKF) and – what is more important – introduced on large scale in the 3 million people region during the years 1999-2001, will be briefly discussed, followed by analysing dynamics of health services and health financing. Particular problems, faced with while introducing every new economic or managerial model into the health care system (political system, as well) will be discussed and solutions applied will be shown.

One general conclusion could have been formulated, namely: introducing a new system, especially those affecting people, their lives and personal life, we should perform previous analyses, computer simulations and OR modelling, rather than experiments on real world. However, as for every simulation model we should assume a starting unstable period, also for large-scale systemic reforms one (politicians) should probably prove some patience and will for problem-oriented discussion concerning problems. The reason for the above statement is a brand new, already announced plan of returning health financing in Poland from market mechanisms towards centrally planned budget-based system. Economic aspects of such a reform would be discussed on the basis of data from Lower Silesian Region and general Public Finance data for Poland, showing trends and possible outcomes.

Österreichisches Bundesinstitut für Gesundheitswesen Working Field „Health Care Planning

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The working field „Health Care Planning“ was established at ÖBIG in order to do basic research and planning in all sectors of the health care system. This especially refers

- to establishment and periodical update of data bases related to health and social care institutions in Austria (linked to a Geographic Information System and together organised within the “Austrian Health Information System ÖGIS”),
- to site and capacity planning in all sectors of health and social care (e.g. hospital sites, hospital beds, physicians in hospital and in free practice, inpatient medical services, biomedical equipment, nursing homes, home nursing),
- to estimation of investment and recurrent costs caused by implementation of proposed planning measures and
- to improvement of overall organisation of health and social care (networking of institutions and optimising of interface management).

During the last years emphasis was put on the Austrian Hospital and Biomedical Equipment Plan (ÖKAP/GGP), which is being periodically revised by ÖBIG together with the Austrian authorities and currently being developed from a plan related to hospital sites and beds towards a plan for inpatient medical services / procedures (last update at December 2000). Other important fields are studies on outpatient care (planning the necessary number of physicians in free practice) and rehabilitation. Thus, the working field “Health Care Planning” is organised in four fields:

- Austrian Hospital and Biomedical Equipment Plan (ÖKAP/GGP)
- Planning of inpatient medical services & procedures (including quality assurance)
- Outpatient care & interface management
- Special planning and consultant services for providers of health and social care

A special service of the working field just recently developed is “benchmarking” for hospitals. In this field ÖBIG offers data to hospitals, which enable them to compare themselves to groups of (supposedly) best-performing groups of other hospitals in Austria in terms of workload, frequency of medical procedures and cost structures.

Since October 2000, ÖBIG is providing consultant services for the development of a Health Care Master Plan (HCMP) for Latvia together with SOLVE Consulting Managementberatung GmbH. The objectives of the assignment are

- to introduce Latvian authorities to western European benchmarks of HCMP;
- to evaluate methodologies developed by the local Latvian consultants and
- to assist and advise the Latvian working groups in developing regional HCMPs, which are linked together in the Latvian national HCMP.

Main focus was on assistance and support in the HCMP process by providing adequate guidelines, international benchmarks and planning methodology and by advising the working groups at the planning and implementation process. These support services were mainly provided by presentations in several workshops and by current comments and reports on intermediate results of the HCMP process. The final report (also containing a final evaluation of the HCMP) was delivered to the Latvian Ministry of Welfare by end of May 2001.

Should Priorities be Quantified?

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Health care priority setting, which has come to prominence in many health-care systems over the past ten years, can play an important role in planning for scarce resources. However, concerns about some of the methodological approaches employed in priority-setting exercises involving the public prompted a major study which was reported previously at ORAHS.[1] Amongst its many findings that study confirmed that, whilst there were several imaginative and innovative approaches to priority setting, many exercises had been carried out with little reference to the considerable body of theory and extensive practical experience of priority setting in related sectors and even within health care itself. The findings of that study and the associated recommendations have been widely disseminated.[2]

A follow-up survey was conducted in 2000, which widened the scope to cover health care priority setting in general, with a special focus on the methodological approaches employed. In addition to the original focus on techniques for eliciting and aggregating values, there was an additional focus on the methodologies for incorporating such values into the decision-making process, including the use of models for priority setting.

This paper draws on the results of that survey, together with the findings of an associated study of waiting list prioritisation, to examine issues associated with quantification in priority setting. Issues identified include problems associated with weighting over-long lists of often non-commensurate and sometimes overlapping criteria, ill-defined objectives, effects of information presentation, and the inclusion of inappropriate criteria. In addition to problems identified in the earlier study relating to eliciting and aggregating values, it was found that the models used to manipulate those values to provide priority 'scores' often appeared to be misunderstood.

Given the evidence that both authorities and individuals find some apparently simple methods too difficult to apply in practice, this paper asks whether a 'technocratic' approach is appropriate. Does the demand for explicitness and transparency in health-care planning and prioritisation actually require measurement and scoring? Are wider dissemination of information about approaches and greater use of specialist software the answer or are the methods being employed too complex for general use? Are users being misled by apparently scientific results? Should priorities be quantified?

1. Mullen PM (1996) Priority Setting in Health Care: Techniques and Pitfalls, pp 105-133 in Kastelein A, Vissers J, van Merode GG & Delesie L (eds.) Managing Health Care under Resource Constraints, EURO, Eindhoven.

2. See, for example, Mullen P & Spurgeon P (2000) Priority Setting and the Public, Radcliffe Medical Press.

Cost-effectiveness of Early Defibrillation: the Case of the Austrian Red Cross

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We developed a decision model to analyse the cost effectiveness of early defibrillation for the Austrian Red Cross. Defibrillation is a process in which an electronic device helps re-establish normal contraction rhythms in a heart that's not beating properly. It does this by delivering an electric shock to the heart. The Red Cross rescue and ambulance service arranges the majority of all patient transports within Austria. In 2000, these transports amounted to over 2 million. To ensure immediate and optimal medical care for emergency patients, Red Cross's mission is to provide care by transporting doctors and medical teams directly to the scene of emergency in vehicles and helicopters.

Coronary artery disease remains the leading cause of death in most developed countries. Many of the victims die from out-of-hospital sudden cardiac arrest resulting from dysrhythmias – most commonly ventricular fibrillation. In Vienna, we had an annual incidence of about 45 ambulance missions with resuscitation attempts per 100,000 population from July 1991 to April 1996. Until recently, only physicians were allowed to manually defibrillate emergency patients in Austria. However, a physician does not always reach the emergency patient in time because not all ambulances are manned by physicians. With the technology of automated and semi-automated external defibrillators dating back to the late 1980s, lays could also use these defibrillators to respond to persons having a cardiac arrest. As a first step, the Austrian Red Cross performed a pilot study of the application of semi-automated external defibrillators by emergency medical technicians in Styria, an Austrian county, in 1998. Because of the success of this study, the Austrian parliament passed the amendment to legalise the use of semi-automated external defibrillators by trained emergency medical technicians in 1999. Soon after, the Austrian Red Cross started to implement this new technology all over Austria.

To demonstrate the cost-effectiveness of semi-automated external defibrillation, we calculated acquisition and maintenance costs of defibrillators, training costs for emergency medical technicians, and hospitalisation costs for out-of-hospital cardiac arrest patients compared to the quality-adjusted life years saved by this intervention. In our decision analysis, we varied both the discount rate for costs and health consequences (0%, 3%, 5%) and the scale of this prevention programme (0%, 25%, 50%, 75%, 100%). Early defibrillation by trained emergency medical technicians is cost effective over a wide range of assumptions regarding key factors in the analysis (below US-$ 50,000 per quality-adjusted life year).

Performance of Austrian Hospital Wards – Comparison Using Two Output Measures

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We investigate the evolution of efficiency and productivity in the hospital sector of an Austrian province for the time period 1994-1996. We use panel data to design non-parametric frontier models (**D**ata **E**nvelopment **A**nalysis) and compare efficiency scores and time patterns of efficiency across medical fields.

As health outcomes hardly can be measured in a direct way we make use of two different approaches for output measurement: In a first approach, we employ the number of case mix-adjusted discharges and of inpatient days, in a second we use credit points, which are calculated in course of the newly introduced diagnosis related group-type financing system. We calculate and compare individual efficiency scores for hospital wards as decision making units (DMU) in specified medical fields. To our knowledge the calculation of ward-specific efficiency scores has not up till now been the unit of non-parametric efficiency analysis.

The concept of efficiency used in the study will be briefly outlined. We concentrate, however, on discussing results for different hospitals and on remarks concerning the relationship between output measures and financial incentives.

Data Analysis and Modelling for the Care of Indians with Diabetes

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Diabetes mellitus is a group of diseases that are characterised by high levels of blood glucose resulting from defects in insulin secretion, insulin action or a combination of both. Diabetes causes malfunctions in the way the body metabolises food and it is a serious, life-long disease, which is currently incurable, but manageable. There are two forms of diabetes: People with Type I, or insulin dependent diabetes, produce no insulin and they need insulin injections to survive; people with type II, or non-insulin dependent diabetes, produce some insulin themselves and their survival depends on dietary control and insulin injections.

Type I diabetes accounts for approximately 5% to 10% of all diagnosed cases of diabetes. The nature of Type I diabetes makes it particularly hard to control and the main treatment programs include home blood glucose testing and daily insulin injections throughout the day. The sufferer must also have a strict regime of exercising and diet.

Type II diabetes accounts for 90% to 95% of all diagnosed case of diabetes. This type of diabetes usually appears in adults who are 40 years of age and over and is most common in those over 55. This is why it is often called "adult-onset diabetes." Approximately over 80% of those suffering from Type II diabetes are overweight. For Type II diabetes, one of two things normally occur:

- Insufficient insulin is produced by the pancreas, or
- The pancreas does produce enough insulin but the body cannot use it and has become resistant.

Diabetes can lead to a variety of serious and life threatening complications and examples are: Retinopathy (eye damage), Nephropathy (kidney problems), and Neuropathy (nerve damage).

Care of people with diabetes is life long and expensive. Disease processes leading to the various complications are complex. These complications develop over time with a range of clinical states. Different people seem to at different risks for the various complications. Data analysis for a study of the risks of various complications for Indian populations together with detailed models at the level of individual patients are needed for effective and efficient care.

In this paper we report the results of a classification analysis, using the Classification and Regression Tree method. We also discuss the development of models in which individuals with diabetes are taken through time and the progress of the diseases is captured. Illustrative data gives an appreciation of the use of the models.

A Decision Support System for Assigning Personnel to Teams in Health Services

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Nowadays finding people to work and stay in Health Services is becoming more and more a problem in The Netherlands. In order to make an optimal use of these scare resources the importance of computer supported scheduling systems is becoming evident. The objective of this research is to develop an optimal decision support system for personnel to work in teams with different functions.

With such a system a scheduler could make the assignments in a shorter timeperiod, more reliable and at least the same quality. In order to reach for an optimal mix of support and user friendliness we used EXCEL for the more administration-datarepresentation parts and FORTRAN for the combinatorial parts. The overall approach followed in this applied research is based on three main steps after the input of the relevant data, which was quite a problem in itself. Firstly, a so-called Availability Matrix is developed which indicates which personnel can be assigned to which tasks, individual based. Next, in order to take into account the team assignment and the working conditions, a Combination Matrix is constructed indicating to which tasks in the week the personnel can be assigned to. Finally, the Overall Schedule is constructed giving a minimal difference between the available working hours and the assigned ones. One of the harder points to tackle was to incorporate Windows.

Complex Decision Making in Hospitals: a Simulation Study for Analysing Logistic Processes

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Simulation provides good solutions for complex situations as known from various industrial studies. Animation enables stakeholders to understand and verify the model. However, the advantages of simulation are rarely known in German hospitals. The paper illustrates how simulation was used in a concrete hospital to model the transportation of goods by an automatic system and now helps improve the processes and the schedule as well as the transportation system.

The Universitätsklinikum Münster, a hospital with 1.600 beds, delivers goods, to wards in containers by an automatic transportation system. These goods include meals, drugs, linen, dishes, garbage as well as medical and sterile goods. The currently used old overhead trolleys will be replaced by an automated guided vehicle next year. This hospital wants to improve its processes simultaneously. The aim is to assure an economic operation of the system as well as a delivery of goods to the right place at the right time and with personnel satisfaction.

Various restrictions are to be considered. While some goods are extremely critical in time of delivery, other goods need short transportation times. A change of the personnel's shifts will probably lead to dissatisfaction and need for good arguments, if necessary. The automatic transportation system has for example a limited number of vehicles and containers as well as a limited capacity of the elevators.

In order to find a good solution which achieves the goals under these restrictions, stakeholders must be willing to change the processes. The first step is to understand the complex system and to learn about the results of changes. Therefore, a simulation model was build by the Fachhochschule Münster together with GBU mbh and Hochschule Wädenswil Dienstleistungszentrum für Logistik & Simulation, two companies which are specialised in industry simulation. We used the simulation tool MedModel. This simulator animates all processes on a personal computer. Thus, the user can observe the daily routine in the model. Statistics and reports show the results over the time.

Policy makers can change scheduling parameters such as the shifts of the personnel, the time when goods are send off, and the number of containers to be delivered. Moreover, the user can change technical parameters such as the number and speed of vehicles and process parameters such as production time in the kitchen.

The first scenarios showed starting points to improve the layout of the transportation system, the organisation, and the schedule. Some technical parameters such as the speed of the vehicles are not yet known exactly, so they have to be adapted according to the planning progress of the new transportation system. By animation of different scenarios, stakeholders can easily understand different problem areas to find acceptable compromises.

Detailed Practical Models for Planning and Managing Hospital Capacities

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This paper is concerned with the planning and management of beds, operating theatres, nurses, doctors, and ancillary medical staff in a hospital.

In a hospital, patient flows, care of the patients, and outcomes of the care are characterised by complexity, uncertainty, variability, constraints, and use of scarce resources. These conditions suggest the use of the modelling approach of Operational Research. A number of models for planning and managing hospital capacities have been produced and reported. We discuss the development and use of very detailed integrated models, at the level of individual patients, that provide very helpful information for planning and managing hospital capacities. These models have evolved through team work by many hospital professionals and a number of Operational Researchers.

A powerful classification module links with the hospital databases to create appropriate patient groups. This module also acts as a link between the hospital databases and the models. Arrival profiles, by month, day, and by hour if necessary, can be rapidly obtained for each of the groups. A common need is to create a number of groups for emergency patients and a number of groups for planned (or elective) patients within each speciality in the hospital. Hospital admission rules, the practices for the care and discharge of the patients, and criteria for the allocation of resources during a patient's stay in the hospital are captured in the models. The models are far too complex for analytical solutions and the models are solved through simulation.

Careful capacity planning is needed when designing a new hospital or when considering changes in the existing capacities. The use of simple spread-sheet models, that use averages only, will typically give false assurances about the levels of service that be provided. The necessary capacities will be underestimated. Our detailed models take uncertainty and variability properly into account. The models can, very rapidly, evaluate a range of practical options for planning capacities. Common concerns during planning are: How many beds, theatres, nurses, doctors and other medical staff are needed for the care of a given case-mix of patients? Our models provide quantitative information in the form of graphs and tables for making good planning decisions.

In UK and many other countries the available hospital capacities cannot cope with the needs of the patients. Long waiting lists and cancelled operations are, unfortunately, rather common. Our models can help in an improved use of the existing capacities.

The development of the models will be described. Case studies will illustrate the power of these detailed models for planning and managing capacities.

Process Management in the Health Care Sector

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After reorganisation and process optimisation in the "blue collar" area, later on in the "white collar" area, the next step is to apply these methods in the public sector. In many countries reorganisation efforts in the health care sector are under discussion for raising efficiency. Process optimisation concepts specifically tailored for the health care sector and enriched with valuable experiences from the industry sector seem to be here a practical way.

The main target of process optimisation in the health care sector is to influence through a continuous improvement of processes in the hospitals combined with a patient-oriented co-ordination of the process chain the success factors in a hospital in a positive way so that the "strong" areas of a hospital are built up, additional areas are created and by this way the productivity is raised.

The talk "Process management in the health care sector" contains the following topics:
1. Lifecycle of a business process optimisation project
2. Theoretical foundations of process management (definitions, business process management tools, model-based process management etc.)
3. How to realise business processes with information technology?
4. Various scenarios of a business process management tool
5. Current trends

Analytical Methods to Assist Hospital Planning

Martin Utley, University College London, United Kingdom
Steve Gallivan, University College London, United Kingdom
Katie Davis, University College London, United Kingdom

When planning a new hospital or a new hospital service, planners are faced with the difficulty of trying to assess the level of resources that need to be allocated. In principle, queuing theory can assist with this, although this is made difficult since some aspects of hospital operation do not conform to the usual assumptions made in order to derive standard queuing theory results. Alternative analytical methods will be discussed that allow estimates to be derived to characterise fluctuations in demand for services. Such fluctuations may arise due to variable lengths of stay and fluctuations in admissions. An example of the application of such methods will be given from a modelling study conducted to inform decisions about the planning of an intermediate care facility at a London hospital.

The Nature and Content of Health Operational Research

Jan Vissers, Technical University Eindhoven, The Netherlands

Health Operational Research is an area of applied operational research that requires specific considerations. Departing from existing definitions of Operational Research the specific context and characteristics of health care OR will be discussed. The discussion will focus on the characteristics of health care operations and of health care managerial decision making. Build on this insight into the specifics of health OR, we will discuss different areas of application of health OR.

To structure applications we will use a combination of a process perspective and the levels of planning in a health care system. As such we distinguish the process of care as perceived by the patient, the process of organising care delivery as perceived by a single provider, the process of organising a practice at the level of a speciality or a department, the process of organising hospital services at the level of the hospital, the process of organising health care services at the regional level, and the process of organising health care at the national level. Most applications of health OR can be linked to one of these processes. The applications used to illustrate the application areas will be mainly based on proceedings of meetings of the Euro Working Group on Operational Research Applied to Health Services - one of the EWG's of EURO that functions from 1975. The paper concludes with further challenges for health OR.

Comparing Alternative Policies for Hospital Admission Planning

Jan Vissers, Technical University Eindhoven, The Netherlands

The current policy for admission planning in hospitals is to utilise the available resources to the maximum, i.e. to produce as much as possible within the constraints of available resources. Waiting lists are used as buffer for variation in the level of production. This policy is increasingly discussed as not acceptable anymore. In the current situation priority is given to optimisation of resource use and the service level is regarded as a consequence. As the awareness of what is acceptable as waiting time increases, it becomes necessary to reconsider the trade-off between service level and resource use.

We have examined the impact of alternative admission policies, i.e.: the "zero waiting time" policy, and the "booked admissions" policy. A "zero waiting time" policy would imply that every patient is treated without delay even when it requires extra resources in case of a fully occupied hospital. One may assume, therefore, that this policy will be resource-intensive. With a 'booked admissions' policy, instead of putting patients on a waiting list, an appointment is made for the admission. The advantage is that the patient knows the admission date in advance. On the other hand, there is a chance that elective patients need to be cancelled when there is an unexpected inflow of emergency patients. Also the use of resources might be higher compared to the current policy.

A simulation model was built to compare these extreme policies with the current policy "maximising the utilisation of scarce resources." The performance criteria considered are the amount of resources required (beds, IC-beds, operating theatres, specialists, nursing staff), the utilisation of resources, waiting time, cancelled patients, etc.

The paper reports on the way the different policies were implemented in a case study hospital with some simplifications in its operating characteristics, and in a simulation model that was developed to compare these policies. Results of the different policies are discussed and used to formulate conclusions on a more balanced policy for hospital admission planning.

List of Participants

To EU due data security reasons (2018 law), this list had to be removed.

Format for Full Papers

Guide for Authors (http://www.elsevier.nl/locate/issn/03772217 similar to EJOR)

1. Presenters at the ORAHS 2001 conference are invited to submit three copies of their papers and a disc containing a Winword 97 file to Marion Rauner. The refereeing process will only start after the editors have received three copies of the paper which contains an abstract and keywords.

2. Manuscripts should be written in English. Authors are encouraged to obtain assistance in the editing of their papers for proper use of English prior to submission.

3. Manuscripts must be typed on one side of the paper in one line spacing throughout, with wide margins (left, right, top, bottom: 2.5 cm). Use font Times New Roman and size 12 point. Pages should be numbered consecutively. A duplicate copy should be retained by the author. Keep the paper within 12 pages. **Submission deadline: October 31st, 2001**. As all papers are refereed, this deadline is absolutely strict.

4. Titles, both of the article itself and of the sections, should be brief and specific. Please use bold font for headings.

5. Name(s) of the author(s): for information retrieval, please specify your name always in exactly the same way; initials or given name first, and family name last.

6. Full mailing address(es), including e-mail, of the author(s) should be given, at the institution where the research has been done. If the current mailing address differs, this should be supplied in a footnote. Please indicate the corresponding author.

7. An abstract should be given with every article. It should be self-contained and understandable by the general OR reader outside the context of the article. It should be free from formulae, specialised jargon, acronyms, and references. It should be specific and between 50 and 150 words of length.

8. Keywords must be included (up to 5).

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12. Figures should be numbered consecutively and have a self-explanatory caption. Please refer in the text to the figure! Special care should be given to the drawing. Except for a reduction in size, they will appear in the final printing in exactly the same form as submitted by the author; normally they will not be redrawn by the printer.

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> [1] M.J. Alves, J. Clímaco, Using cutting planes in an interactive reference point approach for multiobjective integer linear programming problems, *European Journal of Operational Research* 117 (3)(1999)565-577.
>
> [2] A. Jensen, *Traffic, Operational Research, Futurology*, North-Holland, Amsterdam, 1980.
>
> [3] M.J.D. Powell, A view of nonlinear optimization, in: J.K. Lenstra, A.H.G. Rinnooy Kan, A. Schrijver (Eds.), *History of Mathematical Programming*, Elsevier Science Publishers, Amsterdam, 1991, pp. 119-125.
>
> [4] D. Sarkar, W.I. Zangwill, *File and work transfer in cyclic queue systems*, Technical Paper, AT&T Bell Laboratories, Holmdel, NJ, 1990 (Downloadable from website http://...).

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17. One book is available free of charge to the fully registered delegates.

The reference of the conference book is:

Rauner, M. S., & Heidenberger, K. (2003). Quantitative approaches in healthcare management. In Proceedings of the 27th Meeting of the European Working Group on Operational Research Applied to Health Services, Peter Lang, Frankfurt am Main.

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