Issue 2.5

Nosokinetics News …

October 2005

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Nosokinetics building a better world

Hands across the world. 21st Century Magic

Step-by-step, two mathematics professors, Malcolm Faddy in Brisbane and Sally McClean in Northern Ireland have been unpacking the process of geriatric medical care. The data they have been analysing is old. It was originally collected on edge-punched cards. Their results are 21st Century computational magic.

Miracle of miracles, they have developed a computational method which demonstrates the phases of hospital and community care.

The world population is ageing. Billions of pounds are being spent on the human genome project and stem cell research in the hope of health gains in future years. Millions are spent on introducing electronic records and data collection, but little if any money is being spent by government on developing and introducing new computational methods of data analysis.

– Outcome of Hospital and Community Care:

– Males aged 80 years

Male patient aged 80 years admitted to hospital in 1976

Phase	Probability of going through phase	Mean time in phase*	Discharge	Transfer	Death
1	1	11 days	0.085	0.002	0.162
2	0.75	11 days	0.455	0.007	0.068
3	0.22	58 days	0.091	0.053	0.069
4	0.01	455 days	0.001	0.001	0.006

Male patient aged 80 years entering community care in 1976

Phase	Probability of going through phase	Mean time in phase*	Hospital Readmission	Death
1	1	16 days	0.108	0.049
2	0.84	189 days	0.290	0.178
3	0.38	1339 days	0.192	0.184

Faddy, MJ, McClean SI Markov chain modelling for geriatric patient care. Methods of Information in Medicine 2005; 44:369-373

Wherever one looks, decisions are based on averages of skewed data. Little or no attention is given to destination at discharge, or to the outcome in health terms for the patient. The gulf the Nosokinetics Group has to cross is, in the words of Prof Dan Dumitrescu at the Craiova conference, "We must escape from Newtonian concepts of pressure and force and embrace complexity, to develop a more holistic view of health of social care." Sally and Malcolm's work is a "Giant step" in that direction. Three articles in this issue take up that theme.

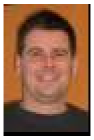
Hands across the world Adelaide HSCM 2006

Our first International Conference on Health and Social Care Modelling and Applications (HSCM 2006), will be held University of Adelaide, Adelaide, South Australia, 19 – 21 April.

Important dates. Abstract deadline 25th November. Notification of acceptance 16th December 2006. Early bird registration 15th January 2006. N.B. Supporters of Nosokinetics News get 10% discount.

Modelling Bed Costs for the Elderly

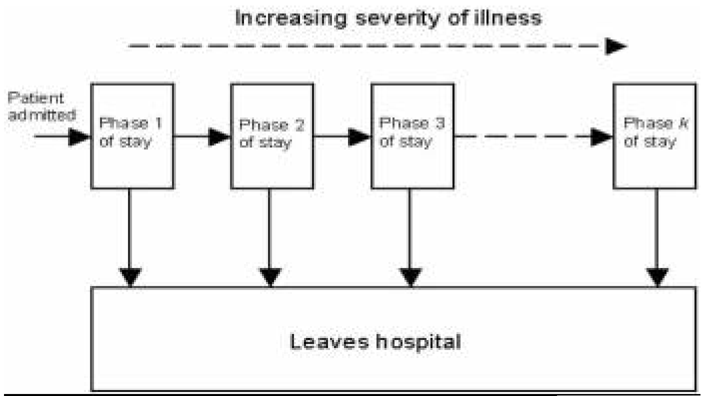
Barry Shaw and Adele H Marshall,
Department of Operational Research and Statistics
Queen's University, Belfast, Northern Ireland, U.K.



Editor's comment
By integrating administrative and clinical data Barry and Adele show how computer assisted data analysis reveals the impact of gender, age, dependency and route of admission on duration of stay and outcome. Furthermore, by adding a cost function, they explain why careful attention to the needs of dependent patients could reduce costs and improves outcome.

Using an extension of Bayesian network (BN) theory and Coxian phase type distributions a method of modelling the cost of inpatient care for groups of in patients is developed. Whereby, survival time in hospital is modelled with respect to the interrelationships between the patients' clinical variables and duration of stay.

Figure 1. Coxian phase type distribution



Coxian phase-type distributions, fig. 1, model the different phases of patients' length of stay in discharge data sets. During each phase, patients either leave - by discharge, death or transfer - or continue into the next phase. Thus the process of inpatient care is represented by different temporal stages.

The Coxian phase-type distribution may then be conditioned on a Bayesian Network to form a Conditional phase-type (C-Ph) distribution.

The directional arrows in the Bayesian network, fig. 2, show the factors that influence duration of stay in a hospital department of geriatric medicine.

Gender influences age, males die younger. Age and reason for admission influence the Barthel score (a measure of dependency) because older people and patients admitted from other hospital departments tend to be more dependent. Finally, the Barthel score and method of discharge influence the duration of stay.

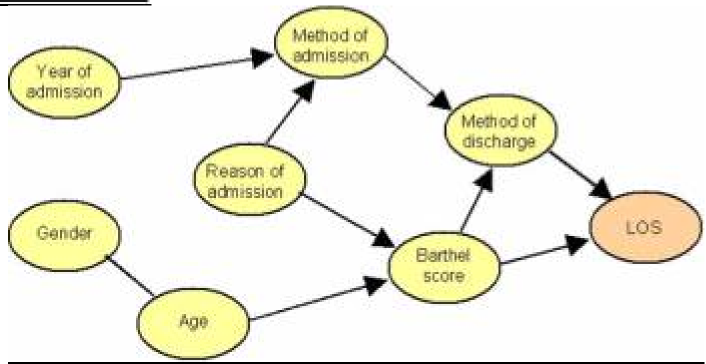


Fig. 2 – Bayesian Network showing how patient information influences length of stay.

Costs per bed day may then be attached to the different phases of care in the Coxian phase-type distribution (as illustrated in fig. 1).

Table 1 (overleaf) shows the estimated cost for 120 inpatients. These costs are representative of the stages of care. The number in brackets represents the number of patients in that cohort. Extrapolating from the data, the average cost of managing a death is £7,164; discharge, £1737; and transfer, £5315.

The four phases in hospital care may be interpreted as short- term (S1), medium-term (S2 and S3) and long-term (S4) care. Patients who enter the later stages of care (S4) stay for long periods of time, as a result they drive up costs, which could be saved if they were enabled to return home.

	Heavily Dependent	Very dependent	Slightly dependent	Independent
Death	£157,610 (22)	-	-	-
Home	£39,383 (22)	£14,009 (7)	£48,557 (33)	£40,544 (20)
Transfer	£30,293 (5)	£23,309 (4)	£24,577 (5)	£6,876 (2)
Total expected cost, C = £385,158				

Table 1 – Expected costs for each cohort of patients

Table 2 displays the cost savings that would occur if the percentage of patients discharged from S2 increased by 20% and S3 by 95%, i.e., If inpatient management could be changed, such that seven fewer patients require long-term-care, the cost of care of the cohort would decrease by 10%.

	Heavily dependent		Very dependent		Slightly dependent	
	Originally	Proposal	Originally	Proposal	Originally	Proposal
% leaving S_2	0	20	0	20	0	20
% leaving S_3	84	95	65	95	82	95
No. entering S_4	9	7	4	3	12	8
Expected S_4 costs	£39,383	£34,312	£14,009	£11,236	£48,557	£41,488
C for those patients discharged home: originally = £142,493; after proposal = £127,580						

Table 2 – Results of "What if?" analysis

In conclusion, the research shows how a Bayesian Network can model the behaviour of patients in a department of geriatric medicine and predict, in a probabilistic sense, the outcome and cost of inpatient care. By altering the parameters in the model, clinicians and managers could identify and discuss possible alternative approaches for cost-effective and life enhancing care.

The research was prize winning at 2005 IEEE conference in Dublin. See **A Bayesian Approach to Modelling Inpatient Expenditure**

Hitting the target

Locker, T. E. and Mason, S. M. (2005) British Medical Journal, 330, 1188-9.

One in eight patients who are subsequently admitted are moved out of the emergency department in the final 20 minutes of the four-hour target period. Data collected in April 2004: 83 departments, 428,593 clinical episodes, 22% admitted. Gaming, satisfies the Minister, what does it do to the patients?

The Emergency Department: Medicine and Surgery Interface Problems and Solutions **online publication** Report of a working party of the Royal Colleges of Physicians and Surgeons. It uses the terminology of modelling systems, but has no models in it. Rather it is expert opinion. Looks at the symptoms and proposes solutions without looking at the cause: bed closures. A bit like Oliver Twist sees the solution in more.

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Bed Management at the Sharp End.

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Professor Emeritus of Pediatrics, University of Alberta, Canada.

Editor's comment: Peter and I trained at University College Hospital, London, UK. At our 1960 graduates meeting we discussed the tactics he used to create 100% bed occupancy.

Irate Physician: "My patient needs admission immediately. I don't give a damn if the hospital is full; discharge somebody, she's too sick to wait"
Harassed Registrar: "But Doctor there are absolutely no beds"
*Irate Physician: "Well b****y well find one! Right now! I'm sending her in".*

Optimal bed utilization is a headache for both clinicians and health care economists and has triggered various strategies for bed management. This is a brief account of one solution to the problem.

During the early and mid nineties the Canadian hospital system suffered dramatic cutbacks in funding and major reductions in bed numbers. Then, five collaborating departments of pediatrics in Edmonton, Alberta, had 130 beds. Two thirds were in the tertiary care University Hospital, the remainder were divided among several secondary level units in general hospitals. All beds were managed as a single system-wide unit. Resident coverage was largely confined to the University hospital creating a strong incentive for pediatricians to admit their patients there if possible. Under increasing pressure we evolved a triage system which allowed us to maintain bed occupancy of more than 100% (as calculated on a once a day midnight bed census) and which effectively ensured that children requiring the specialty facilities of the tertiary center; received them.

At first, the senior resident on call was asked to assume bed control responsibilities but it rapidly became clear that this was unfair and ineffective. Few residents possessed the diplomatic experience or authority to deal with senior pediatricians and their often forceful requests. Next we appointed a paid fulltime bed control physician who nobly performed the task for nearly a year before the stress of daily altercations with colleagues became unbearable. Our final successful approach involved the appointment of a small group of senior (thick-skinned and hard-nosed) pediatricians to act as bed control officers, rotating on a weekly basis, and paid a reasonable stipend. To avoid the emotive "control" we called them Triage physicians.

We established a daily bed status report run by senior nursing staff. Each hospital phoned a central office early each morning and reported the number of empty beds and the number of expected discharges within the next 24 hours. This information was collated by senior nursing staff into a system wide report, which included anticipated elective surgical admissions and which was updated at noon and five pm. Increased same-day surgery greatly reduced the impact of elective surgical admissions. The system-wide bed status was provided to the triage officer whose approval was required for all admissions and their location.

To avoid unnecessary bureaucracy, we introduced a "triage threshold" so that the triage officer only became involved when five or fewer empty beds were available. In-patient stay was tracked and a further responsibility of the triage officer, with the help of nursing and resident staff, was to identify patients whose discharge was delayed and, with consultation with the responsible physician, facilitate a solution. Admissions expected to be short, i.e. less than 24 hours, were admitted to a small observation unit and underwent an abbreviated admission procedure. Such patients were transferred to full admission status if their condition failed to improve in the allotted time span.

1. The key elements of this bed control system included
2. A bed status information system, up datable several times a day.
3. An empowered and financially rewarded triage officer, preferably a senior physician with sound clinical judgment and strong diplomatic skills.
4. The tracking of In-patient stay with identification and rapid resolution of reasons for delayed discharge.
5. The provision of short-stay beds.
6. Control of the system by "frontline" medical and nursing staff, and
7. , Frequent feedback to t he whole medical staff about the need for and intrinsic fairness of the system.

Craiova Modelling the Elephant workshop Ruxandra Stoean

First East European Conference on Health Care Modelling and Computation – HCMC 2005, held in Craiova, Romania, between August 31st and September 2nd 2005.

Editor's comment: *Four mind map drawings were used to underpin discussion at the Craiova workshop. An elephant on a shelf; a basic set of tools, an umbrella in the sky and seven mountain peaks. The workshop discussion focused on the chasm to be crossed between sophisticated 21st Century tools data analytical tools and 19th Century measurement in modern hospital practice. Overleaf Roy Johnston replies and the mind map pictures are shown.*

Buying the elephant. If you buy a china elephant, or any other object, you only need tools to put it on a shelf if you have nowhere else to put it. The new shelf must compliment your new possession, hold the weight and look good. If you don't buy the elephant and / or need a new shelf, then brackets, screws, screwdrivers and electric drills will remain in the toolbox and never be used.

Different viewpoints. Everyone sees the world from the point of view on which they stand. Imagine an umbrella in the sky. What will passers by see? Three people, one underneath, one on a hilltop and one in an airplane will all have different views. Different people, different angles, different views of the same umbrella. Of the elephant. Of the tools we need to put it on a shelf.

Different questions. What tools reflect the elephant? Are the tools we choose suitable for the elephant? How can we modify the tools we possess to suit the problem and how can we build new ones taking into account the old ones? How will the elephant evolve?

Nosokinetics building a better world

Nosokinetics is our elephant. We want to build a better world, and think our tools are useful, how do we sell the idea, if no-one wants to buy? What are the problems and what are the possible solutions? How can healthcare issues be modelled optimally? Toolmakers from around the world, gathered at the round table, brainstormed some ideas.

What are the developers' faults? The healthcare system depends on the country; what kind of tools do they build? Can their tools adapt to changes in the healthcare system? Are their tools more important than the problem? Are they more concerned in developing tools just for the sake of tools?

What are the doctors' faults? Data sets have to be accurate, in order that conclusions are right; can one get such data sets? Is it possible in any country whatsoever to sell tools to hospitals? How can doctors who are afraid that one-day computers will replace them be convinced of their usefulness? How much time do doctors have to learn new technology?

Regarding their common fault. What can be done concerning the difficult and different language of complexity?

What then are the solutions?

For toolmakers: The tools they make have to be dynamic in order to adapt themselves to a changing environment of healthcare services. Take some generic tools, talk to people that need them and modify the tools to suit the problem. Supply a friendlier face to their tools.

For doctors: Need to organize themselves and arrive to a conclusion of what they need; this has to come from the medical field.

For us all: Do not "Mind the gap" in knowledge between toolmakers and doctors, but bridge it! Make a liaison between the people who make the models and the people who need the toolkits. Build the new science to make an interface between academics and buyers; that could also take care of the problem of language complexity

Only when we achieve that, will our Nosokinetics elephant shine happily on the shelf so nicely and firmly pinned to the wall of our home.

Roy Johnston, who works with IMS and has a background in applied maths, gives his initial reaction:

Peter:
On the matter of the 'elephant' is this the best you can get out of that conference? I must say I do not think it is illuminating, with its dubious analogies and implication of 'white elephant' status for nosokinetics.

What is more, it gives a wrong message, namely, that the stakeholders are the modellers and the medics. There are at least 6 stakeholder-groups, namely the managements, the doctors, the nurses, the special service technicians, the suppliers of IT systems, and above all the patients. The latter are the most important in their own right, and they can also influence the managements via the political process.

I do not count the modellers as stakeholders; they are at the meta-level, and their problem is to sell the understanding of the problem structure to management and their associated medical service experts, their potential allies being the IT system suppliers, the patients and the politicians.

The stake of the IT system suppliers is related to their need to support management and clinicians in the avoidance of problem situations. That is why we in IMS are here doing this. So on the whole it would go against the grain from me to edit the 'elephant' paper without serious critical comment.

A final comment, on the nature of the modelling problem. It is evident that we have a strong stochastic component in the arrivals, and a variety of service time distributions. The servicing of a patient with a given condition is likely to involve a complex set of services, for each of which there can exist a queue.

The challenge to modellers is how to adapt the existing extensive and excellent body of queue-theory to describe meaningfully this complex situation, and to lead management to an understanding of the extent to which they need to supply surplus capacity in critical service areas, given that in a stochastic environment, 100% service utilisation implies infinite queues.

Sincerely / RoyJ

Peter replies

Roy,

Thanks for your insights. I should have told you that the discussion was based on four mind map drawings. Clearly, the working paper, struck a nerve. I thought about rewriting it, however, it is the work of a PhD student and they are our future.

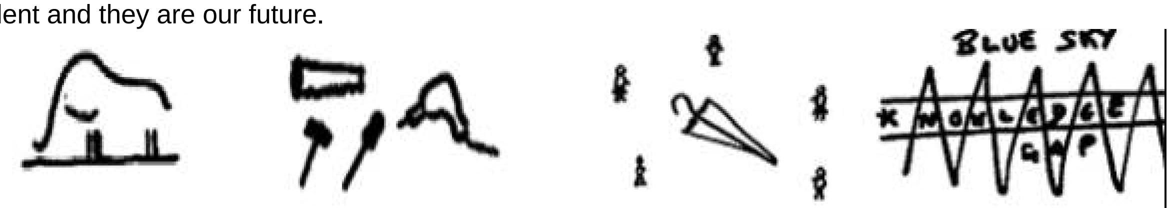

Figure 1. Mind maps - elephant, tools, umbrella and knowledge gap - used in the workshop?

With the mind map drawings the message is clear - and the message is an important one. If the mathematicians and computer scientists who are building methods of data analysis don't talk to / work with health care practitioners, they may create meaningless models. On the other hand, if the doctors cannot understand the language that model makers use and / or the tools are not user friendly, then no progress will be made, and models, useful or not, will languish in the dark and never enter the light of day.

It would be interesting to know what our readers think and I hope many will be stimulated by Ruxa's paper and your response to write in and tell us their views.

Yours, Peter

What's your knee jerk response? Email now and let us know

Australian cancer incidence: good news and bad news

Good news, the incidence rate of cancer in Australia is not expected to increase. However,.the ageing of the population means the number of cases will increase. A report published in August by the Australian Institute of Health and Welfare (AIHW), forecasts that the annual number of new cancer cases will increase by 27,000 from 88,398 in 2001 to approximately 115,400 in 2011. Although not all cancer cases require inpatient treatment, the 31% projected increase has important consequences for bed allocation and patient flow. The 199 page report, "Cancer Incidence and Projections 2002-2011" giving details about projections for all cancer groups can be downloaded free

Special Issue of Health Care Management Science (2005) 8 (3) 187 241

Baker, R. D. (2005). "Preface." Health Care Management Science **8**(3): 187.

Bowers, J., B. Lyons, et al. (2005). "Modelling Outpatient Capacity for a Diagnosis and Treatment Centre." Health Care Management Science **8**(3): 205-211.

Joy, M. and S. Jones (2005). "Transient Probabilities for Queues with Applications to Hospital Waiting List Management." Health Care Management Science **8**(3): 231-236.

Gallivan, S. (2005). "Assessing Mortality Rates from Dubious Data. When to Stop Doing Statistics and Start Doing Mathematics." Health Care Management Science **8**(3): 237-241.

Mackay, M. and M. Lee (2005). "Choice of Models for the Analysis and Forecasting of Hospital Beds." Health Care Management Science **8**(3): 221-230.

Marshall, A., C. Vasilakis, et al. (2005). "Length of Stay-Based Patient Flow Models: Recent Developments and Future Directions." Health Care Management Science **8**(3): 213-220.

Rees, M. and J. Dineschandra (2005). "Monitoring Clinical Performance: The Role of Software Architecture." Health Care Management Science **8**(3): 197-203.

Young, T. (2005). "An Agenda for Healthcare and Information Simulation." Health Care Management Science **8**(3): 189-196.

Taylor, K. and B. Dangerfield (2005). "Modelling the feedback effects of reconfiguring health services." Journal of the Operational Research Society 56**: 659-675**

Demonstrates the use of system dynamics models in evaluating the shift of cardiac catheterization in the UK. The research demonstrates the importance of taking into account underlying feedback systems when changing hospital services.

Footnote: Spreading the word

Members of the Nosokinetics Groups presented sessions at four conferences during the summer months. Thierry and Kevin from the Westminster Group were in Amsterdam, Sally and Adele organised a session at the IEEE conference in Dublin, Elia and Florin organized the Craiova conference and Peter organized a session in Hawaii at the IFORS meeting.

Hawaii was a good opportunity for us to get together again to discuss what needs to be done. The picture shows Peter Gary and Sally working hard in Hawaii. We all look forward to meeting again in Adelaide in April 2006.

Nosokinetics News is mailed to supporters and collaborators interested in developing a scientifically valid approach to measuring and modeling health and social care systems. To be added to / removed from the mailing list email nosokinetics. For contributions, correspondence mail

Editor: Prof Peter H Millard. For earlier editions http://www2.wmin.ac.uk/coiec/nosokinetics.htm

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