Issue 3.2 **Nosokinetics News …** April 2006

Nosokinetics seeking a better world

The Tide is Turning[1]

The River Arun is the fastest flowing river in England. At Arundel, seven miles inland, the river rises and falls 16 feet with each tide. A strange thing about turning high tides in fast flowing rivers is the top is still going up while the bottom is going down.

In the 50's the youth of the town used to tease visitors by jumping off the bridge in the incoming high tide and ending up back under the bridge. I know because I used to do it. I hope I'm not teasing now, for the signs are all there that a new dawn is here.

Hands across the World
University of Adelaide
19th – 21st April 2006

Thanks to the sterling efforts of Mark Mackay & Elia ElDarzi, our sponsors and contributors

HSCMG Adelaide 2006 is heading for success

The programme is on the website. We hope presentation slides will be made available afterwards.

Chris Vasilakis drew to our attention to **"The John Eisenberg lecture: health services research as a citizen in improvement" by Don Berwick.** This heralds a new dawn and sets the scene for new styles of health service research. It's a breath of fresh air.

Using an analogy "Like Russian dolls" Don Berwick sees four interdependent systems. The outer doll is government, the facilitator of facilitators. At Regional and District level are the macrosystems where managers facilitate the aims. Locally, are the microsystems where the care process is undertaken. And right in the centre, the innermost doll, is the patient - the citizen - who experiences the care that is given.

Government should set the aim, not micro manage the system. For aims create systems, not systems the aims. 'Unless we can decide *exactly* what we want to accomplish in the way of reducing human suffering we cannot specify the relevant system to work or whom to involve.'

Without contextual knowledge, scientific knowledge remains sterile. Efficacy (performance under laboratory conditions) and effectiveness (performance in the field) are not the same. Scientifically reengineering health care will not be accomplished by trials and guidelines or by a graduate student or a smart doctor figuring out solutions on a back of an envelope.

Rather, our most accomplished health services researchers, co-operating seriously with quantitative scientists from engineering and related disciplines, must be engaged for the long haul in real world settings to test and prove what they discover. The task is difficult and 'creates for health service research a new level of obligation in its ambition and in its complexity, so that it can take its proper role of citizenship in the very system that it seeks to comprehend.'

[1] Berwick, D. M. (2005). Health Serv Res **40**(2): 317-36. Pubmed

Why does restructuring fail? Research indicates why

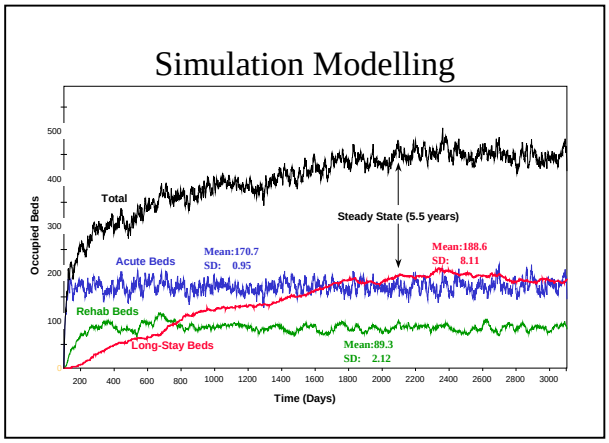
During the last thirty years health care management has changed from a profession led (medical) model to a politically or management led model where objectives are pre-set by those who run the service (Redfern, Christian et al. 2003). The aim is increased efficiency and cost control, yet the evidence for restructuring improving productivity or outcomes is surprising slender (Braithwaite, Westbrook et al. 2005).

A major aim is cost efficiency, but recently published research throws doubt upon the wisdom of constant managerial change. Studying the cost efficiency of change in 20 teaching hospitals Jeffery Braithwaite's group at the Clinical Governance Research at the University of New South Wales, Sydney, Australia conclude that the twelve teaching hospitals who changed structure and the eight who did not were similar in cost efficiency at the beginning and at the end of the study period (Braithwaite, Westbrook et al. 2006).

In further research the group report the conflict inherent in structural change. Three years after Clinical Directorates were introduced at two large Australian Hospitals 227 professionals were interviewed. No one should be surprised that the doctors were both negative and strongly opinionated. In contrast allied staff were more positive but less certain, and nurses' attitudes were polarized and intense but more positive than the doctors (Braithwaite and Westbrook 2005). For change is difficult and change takes time

1. Redfern, S., S. Christian, and I. Norman, *Evaluating change in health care practice: lessons from three studies.* Journal of evaluation in clinical practice, 2003. **9**(2): p. 239-49.
2. Braithwaite, J., J. Westbrook, and R. Iedema, *Restructuring as gratification.* J R Soc Med, 2005. **98**(12): p. 542-4.
3. Braithwaite, J., et al., *Does restructuring hospitals result in greater efficiency?--An empirical test using diachronic data.* Health Serv Manage Res, 2006. **19**(1): p. 1-12.
4.Braithwaite, J. and M. Westbrook, *Rethinking clinical organisational structures: an attitude survey of doctors, nurses and allied health staff in clinical directorates.* J Health Serv Res Policy, 2005. **10**(1): p. 10-7.

Nosokinetics: Light in the Darkness



It's all a question of time, space and behaviour. Hospitals are human activity systems. In such systems people work together with the resources they have got to meet the need. Change is possible but it takes time.

Ministers and their advisors are impatient. They seek glory in the short term and management consultants thrive on their impatience. Success depends on the quality of the leader and the coherence of the plan.

Also, hospitals are simply part of a wider system of health and social care. As drugs have side effects, so does managerial change. As sure as night follows day, closing empty beds in summer causes winter bed crises. Also health and social care services are like the Russian Doll interlocked. Look at the simulation model, from ElDarzi and Vasilakis research at the University of Westminster.

Starting from scratch it takes weeks for bed usage for acute admissions to reach stable state. Months for rehabilitation and five and a half years for the long stay beds required to reach stable state. Given that it also takes two years to change learnt behaviour, it should surprise no-one that constant change fails.

1. El-Darzi, E., et al., *A simulation modelling approach to evaluating length of stay, occupancy, emptiness and bed-blocking in a hospital geriatric* department. Health Care Management Science, 1998. **1**: p. 143-149.

Could a DSS do this? Analysis of coping with overcrowding in a hospital emergency department

Red Ceglowski, Department of Accounting and Finance, Faculty of Business and Economics, Monash University, Melbourne Australia.

Editor's comment: Red reveals how nurse managers in Accident and Emergency departments juggle the patients to meet their targets. Now you see them, now you don't. Like small children playing hide and seek, they can't see you, so you can't see them. Full paper on web.

Emergency Department Overcrowding

Everyone knows that there are occasionally problems with getting fast access to care in most hospital emergency departments (EDs). If you're like me, you take a deep breath when forced to visit an ED and hope that the wait won't be too long. If you're particularly perverse you'll hope that your injury in severe enough for you to be triaged as quite urgent, so you're less likely to wait for treatment.

Ordinarily, however, our fears are unfounded. We are courteously received, efficiently triaged and professionally treated – all within reasonable time. Yet if we look at the numbers of patients passing through a typical ED we see that they run at capacity almost all the time. How do they do it?

We'd love to be able to tell you how ED nurse managers repeatedly solve a hugely complex dynamic non-linear optimisation problem and keep things running relatively smoothly, despite the unpredictability of patient numbers and variety of ailments? They are a special breed. That's about all we have been able to glean from my investigations into how they do it. This article will instead look at just how well they do what they do (put up to 60 patients "into" a '40' bed facility) and suggest how they do it.

ED Operations and facilities

The ED has 33 beds: 8 for acute patients; 5 for paediatric patients; 6 for observation; 5 for general care; 3 for resuscitations; 3 consultation rooms; 3 for triage rooms and 1 isolation room for infectious diseases. Although the beds were allocated based on certain rules, they can also be used interchangeably, with the exception of the resuscitation area.

Patients arrive at indeterminate times. A qualified medical practitioner triages new arrivals: 1 (most urgent) "immediate attention required" to 5 (least urgent) for "attention within two hours" {Australasian School of Medicine, 1994 #732}. Patients go to the first available treatment site (most commonly a bed in the emergency department, but it may be a 'treatment chair' in the case of less serious presentations) and qualified medical staff initiate treatment.

Nurse managers oversee patient traffic flow, in addition to the support provided by the emergency department information system – a computer workflow system gives details of patients in and awaiting treatment but does not provide further decision support.

The data

The data consisted of 56906 de-identified records of all ED presentations in 2002. The records contained demographic information plus details of the visit such as "presentation problem", urgency, key time points and "disposition". Mark Isken's software must solely be accredited with any insights.[2] One of the best features of OpenHillmaker is the graphical output.

[2] Mark Isken, Associate Professor, Dept. of Decision and Information Sciences, School of Business Administration, Oakland University, isken@oakland.edu; http://www.sba.oakland.edu/faculty/isken/

ED Occupancy

Figure 1 shows the typical 'camel hump' of occupancy by day as arrivals gradually increase through the morning and peak in early evening. Notice that the ED staff care for at least 20 patients most of the time and rarely less than 10. On average, the peak occupancy is around 33 beds which makes the administrators happy because it indicates that the ED is big enough and they don't need to spend money increasing the number of beds, no matter how much the staff claim that the ED is overcrowded.

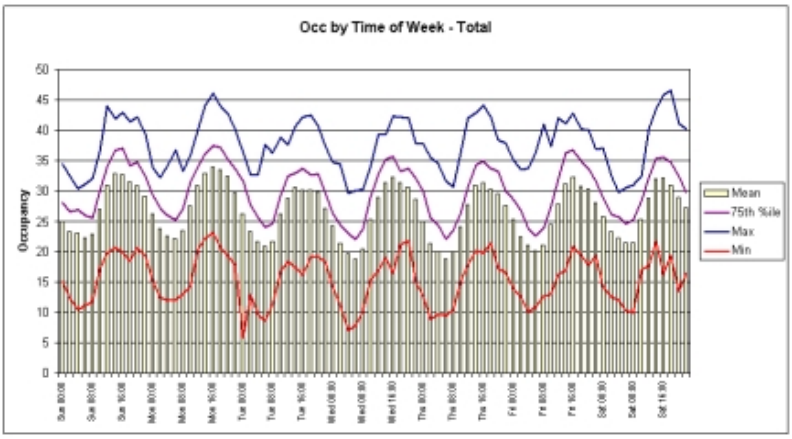


Figure 1 Occupancy in the ED (between being shown to a bed and physically departing the ED).

But wait! What about peak occupancy? How can it be that the ED never has more than 33 patients simultaneously booked in, never mind the figures of 50 that the data shows us? The 75th percentile shows that such overcrowding is not that infrequent, too. Administrators: possibly the ED staff have a point? Look at Figure 2. It's immediately obvious that the bulk of patients in the ED at any given time are awaiting hospital admittance. It's staggering to think that more patients may be in the ED awaiting hospital admittance, than there are beds in the ED.

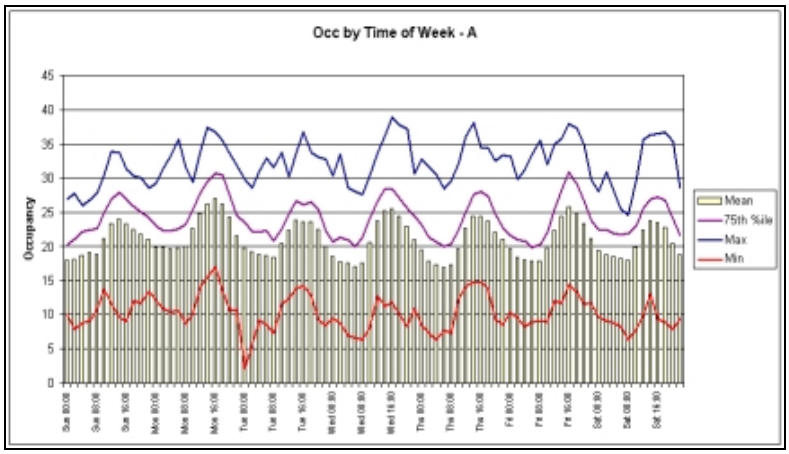


Figure 1: Patients awaiting admittance to a hospital ward

Whence the press cameras and splashes of patients on trolleys in corridors along with sensationalist stories of pain, suffering and neglect in hospital corridors. in the vast majority of cases the ED is 'forced' into treating these patients because of delays in getting them admitted to hospital.

Nurse managers and the Supply Chain

Investigations such as those given above are fascinating and enlightening. They force us to revisit our understanding of the neat, clear process pictures we have and challenge our mental models. So what's happening? How do nurse managers pack them in so?

Anyone who has been a retailer, distributor or wholesaler in the famous "Beer Game" management simulation will immediately have an answer. The task models a supply chain from beer manufacture to customer. Beer droughts and lakes often occur, and a final accounting shows some beer is missing. Not in the players, but in the lorries.

Similarly, some of the extra ED patients are nestled in treatment chairs, squirreled away in consultation rooms, or being treated in triage beds, but most of the missing patients are probably travelling to, or waiting outside, imaging centres or other specialised treatment rooms. How do the nurse managers hold it all in their heads? We don't know, but sure are impressed.

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MASHnews

Edition 2 - April 2006 REPORT BACK:

MASHnet/NHS Confederation Workshop held on Thursday March 2nd in London
Modelling Solutions in Health Care

Over thirty-five delegates drawn from a range of health service backgrounds came together for this workshop which explored the issues of implementing simulation and modelling in the health service. For such a concentration of health service professionals to come together for a day focused entirely on this theme felt an important achievement in itself and due in no small measure to the MASHnet collaboration with the NHS Confederation who hosted the event at their headquarters in London.

The day began with a brief introduction to the aims and activities of MASHnet which was followed by an enlivening keynote presentation by Nigel Edwards (Policy Director at the NHS Confederation). This wide ranging talk spoke of the importance and opportunities presented by modelling approaches in the current NHS. Further presentations by Simon Dodds (Vascular Surgeon at Good Hope Hospital, David Bensley (Operational Research Manager at the Dept of Health) and Peter Millard (visiting Professor of Geriatric Medicine and editor of Nosokinetics) introduced examples of successful application at different levels of the health service and illustrated the potential contribution of modelling and simulation.

The remainder of the day was given over to interactive work in smaller groups. Four sub-groups were assembled based on the backgrounds of delegates; two at acute trust level, one strategic, and one at commissioning level. In the pre-lunch session the groups were asked to outline the major obstacles preventing the better realisation of the potential of modelling in healthcare. There was virtual unanimity in the listings. The following issues were identified as the main barriers to implementation:

- poor awareness of the benefits (especially amongst senior management),
- lack of recognition and low prioritization reflected in lack of resources
- poor availability of appropriate data to drive model
- shortage of in-house skills,
- lack of successful exemplars and champions
- Shortage of accessible tools to apply to real problems
- Diversity within the organisation inhibiting generic solutions
- Poor communication between key professional groups.

The afternoon session was devoted to a game playing exercise where teams competed for a stash of Belgian chocolate to define a promising research project in health service modelling. Many different areas were identified. The trust oriented groups identified a range of potential areas including: financial, meeting the 18 week target, chronic disease models, adverse events, improved access, improving health outcomes, workforce, service improvements, forensic services, and models for elderly care. Service improvement models were seen as a particularly promising avenue for research and development. Two groups, including the commissioning team focused on treatment pathway models as means of assessing alternative treatment configurations. This is becoming increasingly relevant in the emerging era of efficiency targets within the NHS. Simulation models, for instance, could proivide the basis for 'what-if' experimentation to assess the effectiveness of different service configurations. Case study areas (such as diabetes care), were seen as important in order to properly scope the research exercise and demonstrate proof of concept.

Perhaps the most interesting observations arising from the afternoon game play session were the evident mismatches in expectations between the NHS staff and the few academics amongst the delegates. NHS staff clearly work in a different time context to academic research and have very different perceptions about delivery periods.. Whereas health service staff typically expected the modelling projects to deliver within months and on relatively small budgets; those academic researchers present commonly thought in terms of several years and several hundred pounds of funding to deliver a meaningful output from such projects. There were also noticeable differences between the professions about how to properly scope modelling projects, and the groups had difficulty in finding a strong focus to the project proposals. Despite this however it was startling how much progress was made within such a demanding time frame and there was much useful sharing which was shared in the final plenary discussion

This workshop illustrated the clear opportunities that exist in the application of modelling and simulation solutions in healthcare. It also identified many of the key reasons why applications are not more obviously in evidence in the health services. One aspect of this that was demonstrated is the clear separation in perspectives that exists between professionals engaged in delivery and management of services and the research community which can help develop modelling solutions. This demonstrates more strongly than ever the need for these key groups to come together to find a common basis for more fruitful solutions as the UK health service moves into a particularly challenging period of its history.

MASH*net* FORTHCOMING EVENTS AND ACTIVITIES

MASHNET WORKSHOP - 3rd April, @ Cardiff University.
Modelling and Simulation in Healthcare - Shaping the Future

This promises to be an inspiring day. Programme on the web
www.mashnet.org.uk

Queuing Theory: The discussion continues

More on Queue Theory: An ongoing discussion between Roy Johnston and John Preater from Keele University is on the web. John writes:

Roy, what you are saying makes excellent sense and is not outdated. JP: In the queueing literature your (hospital) system is a multiclass (different types of patients with different routes through the various services) queueing network. It is also a loss network (i.e. patients without a bed are either diverted elsewhere - the true 'loss' set-up, or go into an 'overflow buffer' on trolleys): this causes some mathematical hardships. By the way, there is a class of 'loss networks' that is motivated by telecomms problems and which are not relevant.

Recent Papers

Haraden, C. and R. Resar (2004). **"Patient flow in hospitals: understanding and controlling it better."** Front Health Serv Manage **20**(4): 3-15. (link)

Lessons learnt by The Institute for Healthcare Improvement work with 60+ hospitals in the United States and the United Kingdom are discussed. The ED only looks like the problem. The key point is the inability to transfer patient to hospital after decision to admit from ED is made. Initiatives recommended include, separating emergent and planned surgery. Providing a process team for discharge. Synchronising the discharge schedule; Specialised units outside, e.g. for chronic ventilation. Making the nursing home reservation. And extending the chain forwards and backwards by using midlevel providers providers. The challenge to measure flow.

Glickman, T. S. and H. Khamooshi (2005). **"Using hazard networks to determine risk reduction strategies."** Journal of the Operational Research Society **56**(11): 1266-1272.

Hazard networks express the interdependencies between risk factors. Nodes correspond to the hazards and links show how they are interrelated. Reading this theoretical paper, I thought of the links between hospital cleanliness and cross infection and between inappropriate nursing and medical care causing bed-blocking, leading to cancelled operations, and trolley waits. Perhaps hazard networks demonstrate these links.

Fusco, D., C. Saitto, et al. (2006). **"Influenza outbreaks and hospital bed occupancy in Rome (Italy): current management does not accommodate for seasonal variations in demand."** Health Serv Manage Res **19**(1): 36-43.

Time series analysis of daily bed occupancy was used to model bed usage by influenza patients. In winter months bed usage in general medicine increased for influenza patients by 51% versus 25-32% in other specialties: overall 2.8% of total hospital beds and 7% of general hospital beds were used. The authors conclude that any possible winter bed crisis is probably due to ineffective management of available beds rather than the results of an unmanageable excess in demand. Though without knowing the actual pattern of bed usage, I cannot see how they found this. Then I'm a biased medic

Kok, K., Hayhurst, C., et al. (2006). **The 23-hour ward: an efficient alternative to day case surgery.** British Journal of Health Care Management 12, 15-17

First do no harm. Readmission rates for day case surgery should be no higher than 2%. Audits of ENT day case surgery report same day readmission rates for tonsillectomy of 14%. Allocating ENT patients a bed for 23 hours in a ward opened from Monday to Saturday reduced elective cancellation by 93% and prevented readmission. "Could this be the answer to finally achieving an efficient surgical service with high surgical patient throughput and effective use of beds?" .

Oliveira, M. D. and G. Bevan (2006). **"Modelling the redistribution of hospital supply to achieve equity taking account of patient's behaviour."** Health Care Management Science **9(1): 19-30**(1): 19-30. (link)

Previous methods for analysing the impact of hospital changes have relied on crude assumptions on patients' behaviour in using hospitals. The approach developed in this study is a multi-modelling one based on two mathematical programming location-allocation models to redistribute hospital supply using different objective functions and assumptions about the utilisation behaviour of patients. These models show how different policy objectives seeking equity of geographic access or utilisation produce different results and imply trade-offs in terms of reduction in total utilisation.

SPRIVULIS, P. C., DA SILVA, J.-A., JACOBS, I. G., FRAZER, A. R. L. & JELINEK, G. A. (2006). The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. ***Medical Journal of Australia*** **184, 208-212 (link)**

Mathematically, correlation is not causation, but the findings of this study are intuitively not incorrect. The greater the overcrowding, the greater the deaths. Retrospective data analysis of 3084 inpatient deaths (4.9% of 62,495 admissions in three years) in Perth Hospitals shows a statistically significant correlation between overcrowding and death. Discounting winter the mathematical relationship is still there. Seemingly, men are more at risk, though overcrowding is usually associated with more female admissions. The problem is, the factors associated with increased need are also factors associated with death. Namely, increased age, ambulance arrival, injury, triage score, emergency, overcrowding, physician referral. Editor's comment: To tease out the probabilities of individual risk, a Bayesian analysis would be helpful.

Health Systems Simulation PhDs for 2006.
http://www.hpsig.com/
A$30,014 per year each for 3 years (tax free).
Contact Dr Geoff McDonnell, Director Adaptive Care Systems, Simulation Research Fellow Centre for Health Informatics, Cliffbrook Campus, University of New South Wales. 45 Beach Street, Coogee 2034 Australia

University of Westminster, Health and Social Care Modelling Group Web site
http://www2.wmin.ac.uk/hscmg

Forthcoming conferences

EURO XXI ***21st European Conference on Operational Research, Reykjavik, Iceland July 2-5, 2006*** OR in Health Care Sally Brailsford (S.C.Brailsford@soton.ac.uk) Jan Vissers (vissers@bmg.eur.nl)

OR 48 The Annual Conference of Operational Research Society, Bath, UK, 11-13 September 2006. Bath - a beautiful town with lots of interesting history and culture. See http://www.orsoc.org.uk/ for more details.

RSS 2006 International conference of the Royal Statistical Society. Queen's University Belfast, 10-14th September 2006. contact p.gentry@rss.org.ukn

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