Issue 2.3 Nosokinetics News June 2005

Previous issues at http://www2.wmin.ac.uk/coiec/nosokinetics.htm

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Building a better world

It's on and it's happening down under!

The Nosokinetics Group is pleased to announce that the International Conference on Health and Social Care Modelling and Applications (HSCM 2006) will be held at the University of Adelaide, Adelaide, South Australia, 19 – 21 April, 2006. A flyer regarding the conference will be sent to readers of NK News in a special separate mail-out.

We urge you to make this a priority conference to attend; and to consider presenting a paper

We thank the University of Adelaide (Department of Psychology), the South Australian Department of Health, CHIK Services Pty Ltd and The Health Roundtable Limited for their support.

Peter Millard (International Chair) and Mark Mackay (Australian Chair)

Modelling Queue in an Emergency Department Leon K. Au

University of Melbourne, Melbourne Health and Australian National University

Government funding to look into ways of improving patient flow at the Royal Melbourne Hospital. The first part looks at the way patients flow within the emergency department (ED). Approximately 200000 patient data records relating to patient arrivals through the ED between 1 January 2001 and 18 April 2005 were examined. Some preliminary results are detailed in the following two figures.

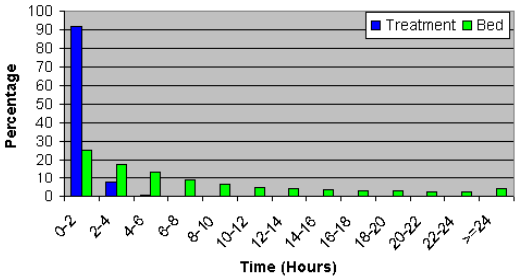


Figure 1: The distribution of the waiting time (time waiting for treatment) and admission delay

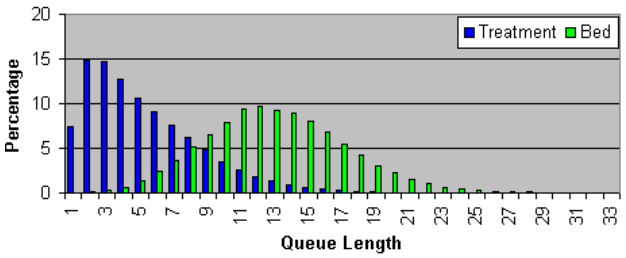


Figure 2: The distribution for the number of patients waiting for treatment and bed admission

Figures 1 and 2 show that more patients wait for beds than wait for treatment and the number waiting for a bed is much greater than the number waiting for treatment. Moreover the time spent waiting for a bed is greater than the time spent waiting for treatment! This was not news to those working in the ED, but the figures provided a simple and clear means of illustrating the issues facing patients in ED.

Research on the possible correlation between the "rate" of patients being treated and admitted to the hospital wards according to the numbers of patients waiting will be featured in the next issue of Nosokinetic News. For those seeking additional information, please contact leon@ms.unimelb.edu.au

Nosokinetics News: Web Archive sponsored by IMS. Thanks to Philip Cooper, Roy Johnston is developing an article archive for us. It's in its early stages and feedback is welcome. Full text links give submitted text: the current issue and back issues remain on Westminster University site.

Can Patient Choice Degrade Health Systems?

Prof Steve Gallivan
Director Clinical Operational Research Unit (CORU) University College, London UK. (full text)

1. Introduction

The United Kingdom is currently introducing health policy to promote patient choice. At first sight it seems morally self evident that it is a good thing to offer choice to patients concerning their treatment, so much so, that it hardly seems worth questioning. However, is this the case?

There are certainly examples of system behaviour in fields other than health care where it is counter-productive to offer system users the right to choose. One such example goes by the name of Braess's Paradox[1] which was discovered in relation to road traffic systems. Here a simple example is constructed showing that, in principle, such behaviour could also occur in relation to health care systems. Whether such odd systems behaviour occurs in real life, is hard to assess, although possibly this is because no one has yet thought to investigate the issue. Even so, it is useful to be alert to the fact that offering choice to patients may not always be a useful goal.

2. A simple illustrative example

Following the ideas of Braess, consider a simplistic representation of the operation of a health care system depending whether or not patient choice is allowed. This is shown schematically in Figure 1. Here we assume that a homogeneous group of patients are treated surgically in one of two different hospitals, with the same 'processing time, but different ways of managing their waiting lists for initial surgical assessment and for subsequent surgery.

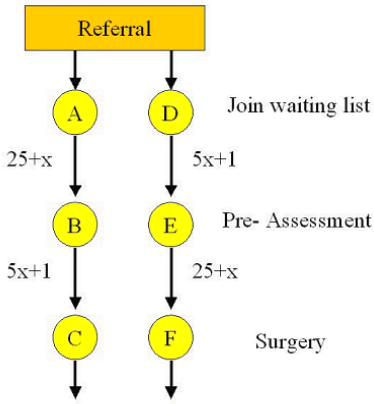


Figure 1. Pathways through a hypothetical health care process with or without patient choice options. Formulae indicate delays for each link dependent on flow of patients x.

It is assumed that three patients per week are referred to each hospital. The hospitals have adopted The waiting times in each part of the care pathway are assumed to depend upon the number of patients treated per week (denoted by *x* in Figure 1). In general, mathematical formulae for waiting times are complex, but here simple linear formulae will be used for illustration purposes (the complexity of individual formulae does not affect the nature of the example).

Without patient choice, since three patients per week are referred to each hospital, the overall 'processing time' for the two hospitals is identical for each patient (44 time units).

With patient choice, two options are permitted. Patients are allowed to decide which of the hospitals they will attend for surgical assessment. Also, following assessment, they may switch to a different hospital for surgery. If all patients make choices that minimise their own overall processing time, then there will be an equilibrium only if the routes chosen through the care pathway network are all individually better that any alternative that is available. Figure 2 shows the configuration of flows for which such equilibrium is achieved. With this, all patients have the same total processing time, 52 units. It can easily be verified that any patient who wishes to deviate from this, would suffer a longer overall delay.

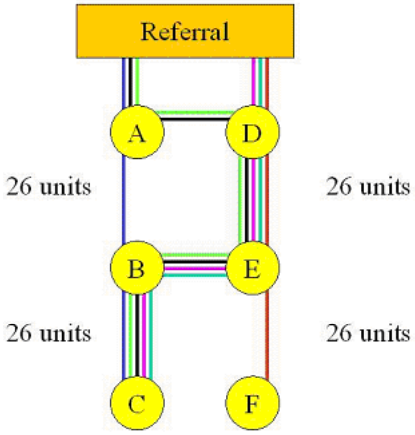


Figure 2. The equilibrium configuration whereby no patient can switch to a different option without incurring greater delay. Different colours correspond to different patients' routes through the health care process.

Thus paradoxically, the overall effect of introducing patient choice increases delays for all patients from 44 units to 52 units

3. Discussion

To understand what gives rise to this paradoxical systems behaviour, it is useful to consider health systems operation in terms of the mathematics of optimisation. Minimum total system delay occurs if patients are optimally assigned to routes through the health care process. This is the so-called 'system optimum' which, for the example given, corresponds to no patients switching hospitals.

Promoting patient choice results in the emergence of a different and rather complex optimisation problem. Rather than a single optimisation problem, assignments arise from group behaviour of numerous individuals, each concerned with optimising things from their own perspective. The resulting patient assignment, referred to as a 'user optimum', corresponds to the assignments shown in Figure 2. This gives a stark demonstration of how the user optimum can differ markedly from the system optimum not only degrading overall system performance, but in this case also dis-benefiting all patients.

While this example is clearly a disturbing possibility, the optimist might trust to luck that such pathological behaviour is unlikely to occur in practice. That may or may not be the case, and at present there is little evidence upon which to base such a view one way or the other. However, what is apparent is that there is likely to be a substantial difference between the system optimum assignment of patients to routes through the health care process and the user optimum. Whether this is likely to give rise to major or minor effects in overall system performance is not known, although the author would conjecture the former. Certainly it would seem sensible to monitor and model the overall systems effects of new schemes

The consequences of Braess's Paradox are taken very seriously in transport planning; indeed the whole topic of driver route choice has been subject to a considerable amount of study. Patient choice in health care is a more recent phenomenon and there has been little opportunity to carry out either theoretical or empirical studies related to system stability properties. The example presented in this discussion highlights potentially disruptive and hitherto unforeseen consequences of introducing patient choice. This suggests that if patient choice is to be introduced there will be a need for a major programme of research to investigate the theoretical and practical consequences.

4. References

[1] Braess, D. 'γber ein Paradoxon aus der Verkehrplannung.', Unternehmenforschung, 12, pp258-263, (1969)

Modelling the future: A policy flight simulator at the acute - aged care interface

AHMAC priority driven research program grant ($A300k over 3yrs)

Key Participants: Len Gray Professor of Geriatrics (University of Queensland), Professor Tony Broe (Prince of Wales Medical Research Institute, University of New South Wales), Diane Gibson (Australian Institute of Health and Welfare), and Geoff McDonnell Simulation Research Fellow (Centre for Health Informatics, University of New South Wales).

Research Question Focus: "How can current service mix and models of service provision for aged care be developed to meet expected changes in demand over the next 10 years?"

A series of future scenarios based on a range of potential policy directions surrounding the acute - aged care interface will be constructed. They will include alterations in the balance of care (between community and residential care), expansion of subacute care and reconfiguration of acute hospital based aged care services. The outcomes of these scenarios will be modeled using a multi-level, multi-method (combined system dynamics and agent based) computer Simulation Model centred around interactions between the 4 key programs that support aged care: acute care, subacute care, residential care and community care.

Welfare state to welfare market; Part 2 Here and now and beyond

Dr. Chooi Lee, Consultant Physician, Kingston Hospital, Surrey, England (full text)

The biochemistry of care

In biochemical reactions, flow is reversible. The predominant direction of flow will depend on the rate-limiting step and the availability of the end product.

Figure 1 illustrates the impact of changing policies on patient flow in the first 50 years of the UK National Health Service (NHS). Before the NHS a rate-limiting step was between the acute hospitals and long stay care. Post 1948, because of the large numbers of people on the chronic sick waiting list, consultant physician responsibility for diagnosis and rehabilitation was introduced into long stay care. First a trickle, then a flood of patients were discharged and the rate-limiting step began to disappear.

During the 1980's and early 1990's, when open access was granted to Board and Lodging Allowance, thousands of older people were admitted from acute hospitals and from home without a period of assessment, treatment and recovery / rehabilitation. By 1990 expenditure was out of control. in 1993 open access to public funds for residential and nursing home

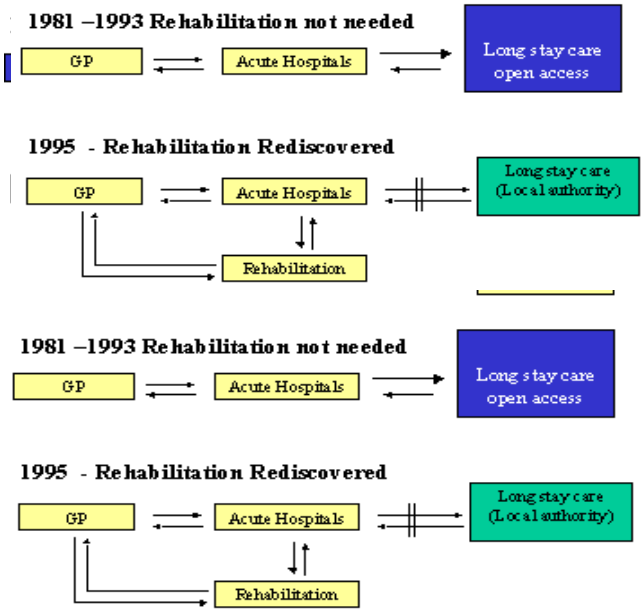


Figure 1. Four '*biochemical*' flow models showing impact of policy change on rehabilitation within the NHS.

care ceased and means testing by local authorities returned, this time as purchasers (not providers) of nursing care. In 1995 the need for recovery / rehabilitation services was rediscovered, not in long stay care, but in intermediate care.

Real-life priorities for acute hospitals

Acute hospitals now run with near 100% bed occupancy and 'Winter' bed crises now last over 6 months of the year. There is increasing emphasis on decreasing patients' length of stay. Figure 3 shows changes made between 1959 and 1995 in bed allocation for acute medicine, acute surgery and geriatrics and Figure 4 shows the downward trend in average length of stay during the same period in all specialties in NHS hospitals in England and Wales.

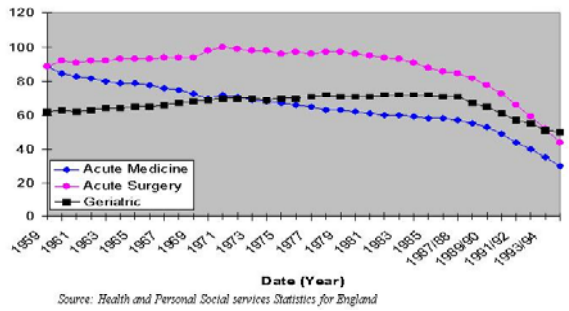


Figure 2. Average daily available beds in acute hospitals: Great Britain 1959-1995

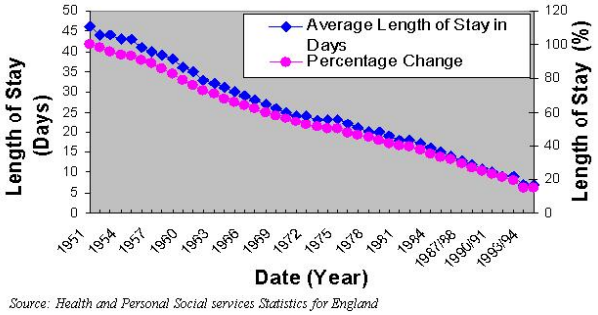


Figure 3 Change in length of stay in NHS hospitals: All specialties in England and Wales 1959-1995

Continued page 4

Tactics include early discharge schemes involving intermediate care, discharge co-ordinators, bed managers and nurse-led discharge teams, and discharge to community hospitals, residential and nursing homes with 'rehabilitation' beds. Hospital resources are spent trying to meet government targets, including 4-hour waiting times, reducing delayed discharges, waiting list initiatives and 2-week cancer referral times. Severe restrictions on staffing levels and recruitment are placed throughout the trusts in order to break even financially.

At present, acute hospitals aim for an average length of stay of about 6 days per patient, regardless of age or medical conditions. The elderly 'bed-blocker' is unable to meet this target due to bio-psycho-social factors. He/she becomes a 'square peg in a round hole'.

The Giants of Geriatrics

Immobility, instability, incontinence and intellectual impairment are the Giants of Geriatrics(Isaacs 1969); multiple causation, chronic course, deprivation of independence and no simple cure are common characteristics. There is immense heterogeneity and complexity; many medical conditions, each running a chronic cause, create dependence. So many older people take longer to recover following an acute illness than younger persons.

The bio-psycho-social model

Figure 4 illustrates how a person's independence and coping behaviour depends on many interacting psychological, social and biological factors. An elderly 'bed-blocker' or 'delayed discharge' may well be medically 'stable' for discharge, but will have at least one medical condition that impacts on his/her psychological and social factors to the extent that he/she is not safe to be discharged from hospital immediately.

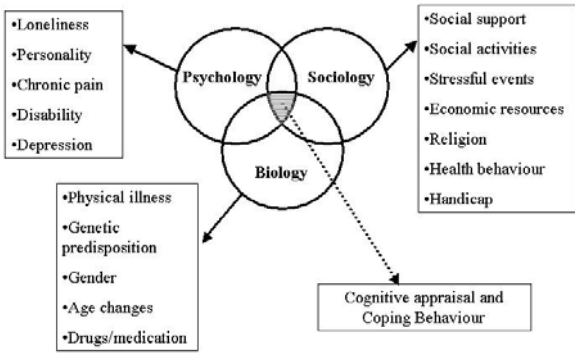
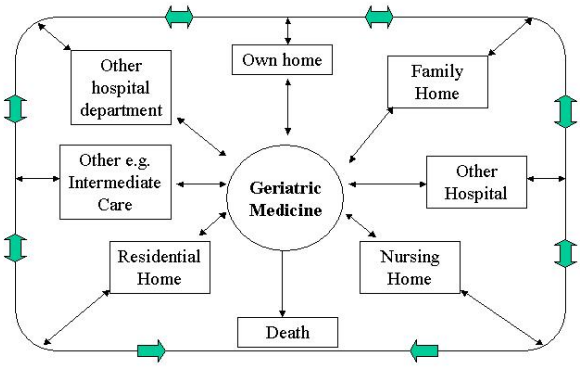


Figure 4. The bio-psycho-social model shows how a person's independence and coping behaviour depends on many interacting factors.

The Way Forward

Traditionally, Geriatric medicine filled the central role, however, within the NHS it is increasingly unable to do so because:

a. Integration into acute care (with its benefits of equal access to acute medical services for the elderly)
b. Shorter lengths of stay and shorter periods of rehabilitation, and
c. Loss of control by the NHS Hospitals of the care of the chronic sick



Now it is unclear which department or agency is better suited to the central role. Perhaps community matrons, as proposed by the present government, will lead the way in chronic disease management in the community. Alternatively, perhaps a new, hospital based, consultant led service 'xyz'(Cang 1977) or 'gerocomy'(Millard 1991) should emerge like a phoenix from the ashes of the past.

References

Cang, S. (1977). "An alternative to hospital." Lancet **i**: 742-743.
Isaacs, B. (1969). "Some characteristics of geriatric patients." Scottish Medical Journal **14**: 243.
Millard, P. H. (1991). "A case for the development of departments of gerocomy in all district general hospitals." Journal of the Royal Society of Medicine **84**: 731-733.

Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. DM Fatovich MBBS FACEM (full text)

Access block refers to the situation where patients in the Emergency Department (ED) requiring inpatient care are unable to gain access to appropriate hospital beds within a reasonable time frame. We systematically evaluated the relationship between access block, emergency department overcrowding, ambulance diversion and emergency department activity.

Emergency Department overcrowding (r=0.96; 95%CI 0.91-0.98), ambulance diversion (r=0.75; 95%CI 0.49-0.88; see Fig) and waiting times for care (r=0.83; 95%CI 0.65-0.93) were strongly correlated with high levels of ED occupancy by access blocked patients. Total attendances, admissions, discharges and low acuity patients were not associated with ambulance diversion.

The figure illustrates the correlation between the rise in access block ED occupancy and the total number of ambulance diversion hours between 2001 and 2002. Between 2001 and 2002, the proportion of access blocked patients increased from 11% to 16% (45% increase, $p < 0.001$)

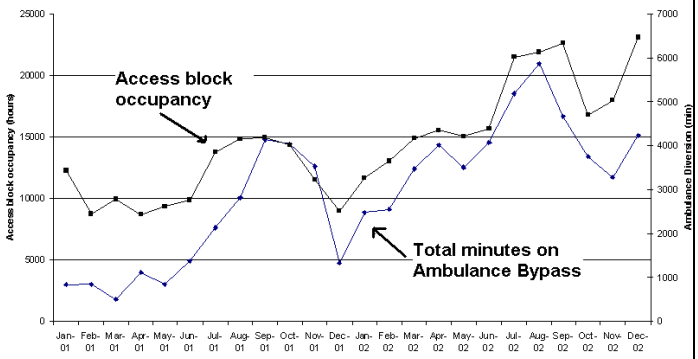


Fig 1 - Relationship between access blocked Emergency Department occupancy and ambulance diversion:

Reducing access block should be the highest priority in allocating resources to reduce ED overcrowding. This would result in reduced overcrowding, reduced ambulance diversion and improve ED waiting times.

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Improving hospital inpatient flow, which would directly reduce access block, is most likely to achieve this. Conversely, decreasing low acuity patient attendances will have minimal impact on decreasing ambulance diversion and ED overcrowding.

Reference

DM Fatovich, Y Nagree and P Sprivulis (2005). Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. Emerg. Med. J. 22:351-354.

The Victorian patient flow collaborative

Marcus Kennedy, Director of Emergency Services, Royal Melbourne Hospital

The Victorian Patient Flow Collaborative is an ambitious innovation program designed to minimise waiting throughout the patient journey and to improve the quality and safety of patient care.
The Patient Flow Collaborative is a joint initiative between the Clinical Innovation Agency (CIA) and the Hospital Demand Management (HDM) team from the Metropolitan Health and Aged Care Service.
All metropolitan and large rural health services (21 Hospitals) from Victoria participate in the 18 month collaborative project. It is providing 18 months of whole system innovation and capacity building with improvement leads based at each site. A whole system approach to innovation, focusing on improving service delivery across the entire healthcare system is being implemented in four key phases:

- diagnostic - conduct rigorous diagnosis to identify whole system constraints
- innovation - develop and test innovations to minimise flow constraints
- improvement skills building - develop service improvement skills and techniques (cont p7.)

- mainstream - spread innovation across other clinical areas and hospitals, ensure sustainability and embed innovation practice.

The Patient Flow Collaborative uses a range of tools to test and measure patient flow processes. Constraint Theory and Lean Thinking methodologies are integral to the program methodology. As the project has matured, increased interest in understanding queueing theories and modeling systems has occurred, to assist organisations in anticipating demand and creating capacity to match and manage this demand.
Gains across the system are starting to be realised, with examples of quite dramatic constraint unlocking occurring in several areas. After the 1st 12 months, the work of this group is really a starting point only; long term adoption of at least a quasi-industrial approach to understanding patient flow is still to be established widely.

Gaming in A&E. *BMJ* (21st May) 2005; 330: 1188-9
One in eight patients admitted from A&E moved out of the department in the final 20 minutes of the four hour target period; UK data: 83 departments, 428593 patients, 22% admitted.

"Healthcare Quality Improvement and Implementation Science."To be published by BioMed Central, the new journal will focus on thestudy of methods to accelerate the implementation of evidence-based clinical practices in routine healthcare settings

Forthcoming conferences: also see http://www2.wmin.ac.uk/coiec/nosokinetics.htm

IFORS Hawaii? July 11-15, 2005: Website

31st Annual Meeting of the EURO Working Group on OR Applied to Health Services (ORAHS) 31 July - 5 August, 2005. Location: University of Southampton Contact: Sally Brailsford Website: www.management.soton.ac.uk/orahs . Held in parallel with a EURO Summer Institute on OR in Healthcare, see www.management.soton.ac.uk/esi.

The First East European Conference on Health Care Modelling and Computation (HCMC 2005) Craiova, Romania: 31 August to 2nd of September 2005. Conference organisers Florin Gorunescu **and** Elia ElDarzi

OR Society Conference, University College Chester, 13th - 15th September 2005. Chris Sherlaw-Johnson (c.sherlaw-johnson@ucl.ac.uk) or Gillian Mould (g.i.mould@stir.ac.uk)

MASHnet launch Tues 20th September 2005 12.00 – 5.00pm hosted by the West Midlands Operational Research Society in the new building at Warwick Business School. MASH net is an EPSRC network for modelling and simulation in health care. Further information contact Martin Pitt

Thank you for your continued support. Nosokinetics News is mailed individually 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.