

**Introduction.** At the start of our fifth year, the focus changes from the development of tools, to the use of tools to explain the process of care. A letter from Cairo from Ahmed Shawky (Page 2) opened my eyes. Page 3-4 considers the model which preceded the mathematics and the gulf we have to cross to change the prevailing paradigm in health and social care. Page 5 looks back at the 1981 Bolingbroke long-term care project "The Best for the worst". Page 6 Mark Mackay and Pam Castle in Adelaide describe a tool to measure what workers do. Pages 7-8 news of UK meetings and NHS grants.



## HSCM2008 at Portrush on 18th -20th March 2008

Sally Mclean, the doyen on mathematical modelling, albeit not dressed so smartly as in academe, looks forward to meeting those of our readers who can make it to our second conference. Registration from 11.00 am Tuesday 18th March. Meeting ends at lunch-time on Thursday 20th March. Followed by a coach trip to the Giant's causeway.

**Keynote Speakers:** *Professor Thierry Chausalet (University of Westminster), Professor Don Campbell (Monash University), Dr Ken Fullerton (Queens' University Belfast), Professor Gary Harrison (College of Charleston), Professor Peter Millard (Emeritus, St. George's, University of London) and Professor Terry Young (Brunel University).*

Still time to register at <http://info200.infoc.ulst.ac.uk/events/hscm2008/organisation.html>

## Light in the darkness 1

Easter is earlier this year. It's a hundred years since Ash Wednesday followed so soon after Christmas. Some religious festivals follow the phases of the sun, others the phases of the moon. Christmas the sun; Easter the moon. The winter solstice heralds the rising of the sun.

At Newgrange in Ireland, near Dublin, there is a 3000BC 'megalithic burial chamber' which heralds the rising of the sun. On three mornings a year, from the 21st to the 23rd of December, the sun rising over a nearby hill sends a beam of light into the central chamber. A picture in the Irish Times of the 22nd February 2007 shows a remarkable sight. The sun shining down the narrow passage which leads to the central chambers, and the shadow of a woman bending in homage to the sun.



Its called a megalithic burial chamber. Though why anyone would build a totally dry tomb with three chambers, one of which has two large stones that clearly could be used to grind corn beats me. Rather, and not just to be perverse, I like to think of it as being the grain store of the Neolithic people as well as a place of religious worship. Moreover the outside has large stones all round it with three interwoven circles, and similar shapes can be found in the Orkneys and in Malta.

"What's all this got to do with Nosokinetics?" you may well ask. Well we were in Malta this year following the megalithic trail and we came across this carved boulder near the catacombs. Six lines, three on each side of a carved circle with a central circular stone in it. Six lines - the Chinese Book of Changes. Six line hexagrams, 64 ways that one can change a system with six lines. The phases of the moon, the yin and the yang, circling the sun. Perhaps?



Our youngest son, David lives in Ireland on the Beara Peninsula. When we are there we look at the stars, which shine so brightly where there is no artificial light. And we think of the chaotic processes of change plaguing health and social care systems, seeking instant success where instant success cannot be achieved, and we wonder why?

**Where to Next? : Vocabulary Needed**—Ahmed Shawky (Cairo) wrote  
Dear Sir

Congratulations on issuing the 24th newsletter. Merry Christmas. As regard suggestions: I suggest adding to the newsletter each time some definitions "standard definitions" of the technical vocabulary and words written in its articles. This is because, for myself, I find some difficulties understanding some parts of the articles, due to the differences in concepts and in the meaning and perception of each word by each person.

We all have different cultures, administrative terms, administrative slang at our hospitals and health system. Also each new science after its beginning to be established must put strict, straight forward, definitions to its terminology.

Perhaps English health care environments are nearly the same as Australian, Canadian and New Zealand systems; but I think they differ significantly from the American, European and our Egyptian health care system (which is a combination of English, American and European). I think, including definitions would help more people to understand more Nosokinetics and help it to grow.

Wish you good luck and success in 2008

Ahmed Shawky,

Resident in geriatric medicine, Ain Shams University Hospital, Cairo, (second from the left)



### Creating the knowledge base: now that's a challenge

Dear Ahmed,

Thank you. You've hit the nail on the head. As Mark Mackay said, "We need to find the 'tipping point' between ignorance and knowledge. In some small way, I have attempted to do that, using Nosokinetics News as a vehicle to spread the good news. How do we cross the Rubicon, the knowledge gap between the small stream of awareness in academe and the wide world of clinical and social care? What better way could there be than to help enthusiasts, such as yourself, to understand the language that we use.

Consider the word 'Bed-blocker'. For me it was an opportunity, for others a threat. How often do you hear clinicians, managers and politicians blaming others for their failures. Also see research papers from Academe (Clinical, Operational and Economic) which conclude that there would be no problem in acute hospitals if only the right sort of patients came in.

Similarly, the temples of Aesculapius in Ancient Greece excluded the hopelessly ill, as their presence would not bolster the reputation of the temple for cure (Bettman 1956). Likewise, an 1808 minute of the Dundee Royal Infirmary medical staff committee notes that patients with no prospect of recovery were not "proper objects" of the infirmary which was "never intended to be an almshouse or poorhouse." (Rosen 1967)

But the world need not be like that. We cannot choose whether the sun will come up or down as the world goes round, but we can choose how we measure, model and plan health and social care systems to meet the needs of all citizens, not just the chosen few.

The prevailing political mantra "We can't afford it" actually means "We don't want to", so no-one thinks, is there a better way? What would our health and social care system look like if we could afford it? Would we plan 'The 'Best for the Worst' with a highly trained staff rationing long-term care, by excellence in hospital based community supportive care. I doubt it, but this is what we dreamed off and for one short moment in time (1981 –2005) in a small hospital (now closed) we achieved it. (see page 5)

The Nosokinetics challenge is to create a theory based on concepts of time and space, not pressure and force - a science base, which crosses national and international boundaries, and enables sustainable health and social care systems to be created and to evolve to meet changing needs

Thanks for writing, and for your thoughtful contribution,  
Best wishes for success in your chosen career,

Peter Millard

Bettmann, O. L. (1956). *A pictorial history of medicine*. Springfield, Illinois, Charles C. Thomas.

Rosen, G. (1967). The hospital: historical sociology of a community institution. *The Hospital in Modern Society*. E. Friedman. New York, The Free Press of Glencoe: 1-36

## Nosokinetics—Changing the Paradigm in Health and Social Care

### Introduction

Bed crises plague modern hospitals. Why should that be? There are insufficient beds to meet the need for inpatient care. What should be done? Build more beds, can't afford that. Modernise. Easily said. Blame the doctors. Stop inappropriate admissions - complex cases, with social problems (bed-blockers) from coming in. Speed up discharge, shorten length of stay. Fine social services for not clearing hospital beds. Yet somehow, bed crises don't go away, so every two or three years the UK government changes the rules.

Problems with health and social care systems are easy to describe, but difficult to change. Human activity systems take five to six years to change, whereas politicians change every three years. So, seeking short term personal gains rather than long term stability, constant change bedevils clinical care and the patients suffer. There has to be a better way.

### The roots of nosokinetics

The roots of nosokinetics lie in a 1972 post-ward round discussion in a small hospital in Wimbledon, when we recognised that the discharge of longer stay patients was distorting the computer generated average stay. Hospital Activity Analysis was introduced to inform consultants about their work, but our returns were not correct. Since then much has happened in the stream of life and in the practice of medicine, but, the computational and conceptual errors in the accuracy and use of average length of stay still remain.

As table 1 shows, the gap to cross before sophisticated mathematical models can be introduced is huge. It's a preliminary trawl, indicative of trends, however, note that the words exponential 25 hits, quartiles (29), skewed (30) and percentiles (102) occur in less than three in a thousand publications containing length-of-stay (37,584).

There's a long way to go, but like a carp touching the top of a pond spreading ripples to the edges, or the flapping of a butterfly's wings in the Brazilian jungle causing a hurricane in the Pacific Ocean, nothing happens unless something begins.

From 1950 to date, the word average can be found in 305263 papers in the Medline database (Table 1). Between 1950 and 1970 a simple formula was used to calculate the average length of stay.

$$\text{Length of stay} = \text{Beds} \times 365 / \text{Admissions}$$

Now computers calculate the length of stay, which is seemingly more accurate, but anomalies occur because:

1. **The computer counts the nights of bed occupancy not days of bed use.** Hence, patients admitted and discharged on the same day have zero days inpatient care. Once recognised it can be overcome by adding 1 to the length of stay, so 0 days = 1, 1 day = 2, etc., but this is rarely done. Hence planners and modellers underestimate the need for inpatient care. (continued overleaf)

### Box 1. MISMATCH in THEORY and PRACTICE

#### Changing Human Activity Systems takes Time\*

Year One: Create the plan and employ the staff

Year Two: Newly appointed staff plan the change.

Year Three: Chaos

Year Four: Benefits begin to emerge

Year Five: A new stable state appears.

\* Paul Thornton personal communication

Every three years politicians change\*\*

\*\* Ian Ayres personal communication

**Table 1. Key words in 37,584 papers with length of stay\***  
Source: Medline 1950

| Search term   | Number of hits | With Length of stay | Nosokinetics Group |
|---------------|----------------|---------------------|--------------------|
| Exponential   | 25133          | 25                  | 7                  |
| Quartile\$1   | 3309           | 29                  | 0                  |
| Skewed        | 4649           | 30                  | 1                  |
| Markov        | 8187           | 32                  | 4                  |
| Percentile\$1 | 14155          | 102                 | 2                  |
| Destination   | 2749           | 146                 | 1                  |
| Meta          | 285            | 285                 | 0                  |
| Discharges    | 110755         | 572                 | 27                 |
| Random        | 162062         | 612                 | -                  |
| Occupancy     | 10108          | 636                 | -                  |
| Admissions    | 21568          | 2745                | -                  |
| Controlled    | 574538         | 4241                | -                  |
| Average       | 305263         | 4853                | -                  |

\* accessed February 2nd 2008; - not searched

**2. The destination at discharge is rarely reported.**

Only 572 (1.5%) of the 37,584 papers contained the word discharges and only 20 included the word destination. This is a serious problem, because discharge is directional and there are major differences between the outcomes death, transfer, and discharge to own home, or to alternative accommodation with relatives or in residential and nursing homes. So length of stay is not a scalar, it's a vector, and more than one number is needed to describe the outcome of inpatient care. Consider Miss World, 36,24,36, no way could she be described by one number and the same is not untrue for the use of average stay to describe clinical reality. .

**Modelling the process of care**

Figure 1 shows the topological model which underpins the Nosokinetics agenda, see (Millard 1988) In 1905, topology was a 'comparatively new science by which, from the study of geographical facts about a locality, one can draw deductions as to its history (Oxford Dictionary of Historical Principles). In 1917 D'Arcy Thompson wrote:

*The waves of the sea, the little ripples on the shore, the sweeping curve of the sandy bay between the headlands, the outline of the hills, the shape of the clouds, all these are so many riddles of form (D'Arcy Thompson 1917).*

Like the rising and falling tides depends on the phases of the moon, so the number of hospital inpatients change, dependent on the time of day, the day of the week and the season of the year. As the sea never empties as the tides rise and fall, so all of the beds are never empty, as patients come and go..

In his book, Structural Stability and Morphogenesis , Prof Rene Thom wrote:

*'Either we must stop asking "Why" or we must seek to extend our intuition to new levels, to see that processes and events have shapes of their own.'*

In Figure 1 the historic sequence of dates of admission creates the **temporal map**. The long stay beds are the **attractor**. Exponential analysis of occupancy time reveals two streams of flow. The **vector field** reflects the discharge process in the short stay beds. And the **catastrophe hypersurface** is the hidden threshold, caused by case-mix and degrees of difficulty, separating short stay and longer stay patients. The **logical succession** reflects what would happen if what happened in the past happened in the future. Which, as Figure Two shows is not always true, for structural and behavioural changes within and without human activity systems can influence the process of care. But that's a different story. For the mathematical solution to the two compartment model

See

Harrison, G. W. and P. H. Millard (1991). "Balancing acute and long-term care: the mathematics of throughput in departments of geriatric medicine." *Methods of Information in Medicine* 30 (3): 221-8.

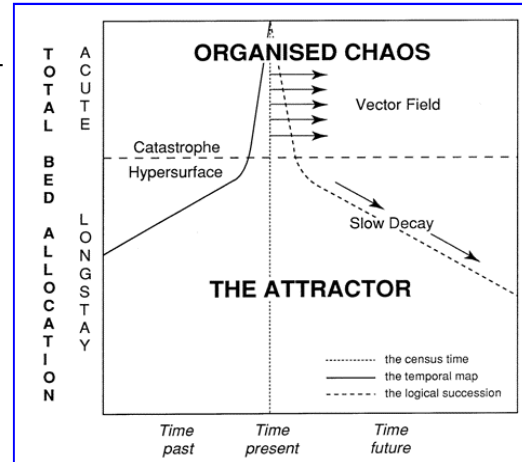


Figure 1. Topological model of a department geriatric. Creating order within disorder in clinical services. Using 'snapshots' to describe the process of care and predict time future.

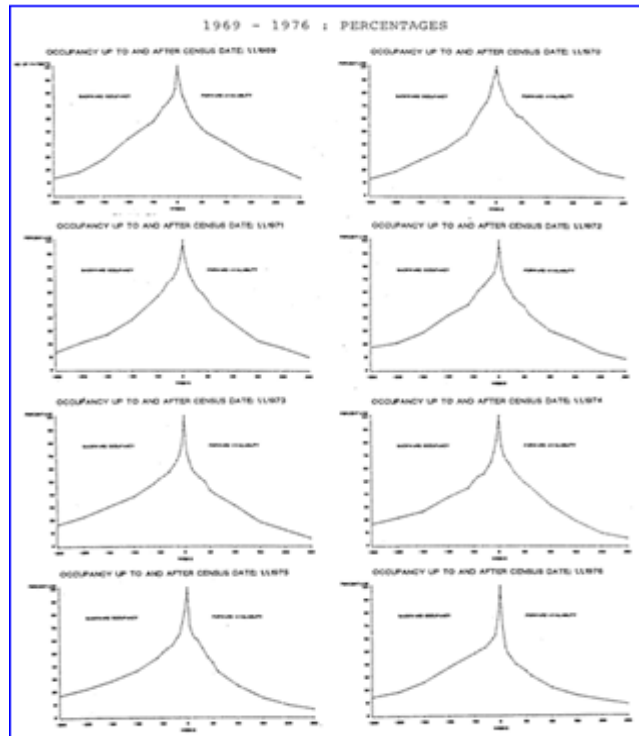


Figure 2, Backward and forward bed occupancy (percentiles) of the inpatients occupying beds in the Merton department of geriatric medicine on the 1st of January in the years 1969 - 1976.

## Living the dream: The Bolingbroke Long Term Care project

Opened in 1981, the Bolingbroke Hospital long term care project provided single room accommodation for nine long stay patients and six bedded unit for community supportive respite care. Academic support from Hotel and Catering, University of Surrey, Brian Boothby from Designing for the Disabled at London College of Furniture, Brian Hitchcock architect from the Department of Health and involvement of patients and staff were essential components of success.

Key features of the personalised accommodation were: .

- ♥ Separation of public and private space; entry into day space,
- ♥ Name plates on the door, in vinyl letters; no entry without patient permission.
- ♥ Fabric covered panels giving choices of colour and style;
- ♥ Own pictures on walls,
- ♥ Bedside locker and wardrobe hanging from a rail, so room could be adjusted to meet changing needs.



The roots of the project lay in a 1976 visit to Denmark, where personalised single room accommodation in nursing homes is the rule. Followed by a study involving medical students viewing pictures of patients with and without my family photos on their lockers (Millard & Smith 1981). Creating a demonstration personalised single room. And finally, to the vision of the ten patients in the long term care ward who allowed us to make their lives more difficult in full knowledge that not all of them would benefit.

The pictures show both the layout of the rooms and Miss J in her room in the first week of its opening in 1981. She had been admitted from a residential home with osteomyelitis of her jaw due to a pressure sore between her clavicle and jaw. Her active involvement as occupant of the demonstration room, praising its virtues to visitors, set the scene which enabled and facilitated the success of the project.

### Postscript: Unexpected consequences

In 1981 the Minister of Health officially opened the project. Then our vision was that other hospitals would take up the challenge and upgrade their accommodation for long stay patients. Sadly, that was not to be. The same year, a Department of Health working party made two recommendations that dramatically changed geriatric medicine. First they accepted that the UK could not afford to provide age related geriatric medical services. Then, because 41 health districts had no geriatric medical beds in the district general hospital, and nursing research indicated that the dead hand of consultants was responsible for the poverty of long term provision. The working party recommended that nurse leadership should replace consultant leadership in long-term care, and that districts without acute geriatric medical beds should develop the integrated style of geriatric medicine (Department of Health 1981). Despite the fact that there was no evidence. I quote:

*'...with regard to experimental areas such as Newcastle and Oxford. It is, however, too soon to know whether these will be more successful than specialist departments. In the absence of objective data or scientific evaluation of either geriatric services or integrated medical services the argument cannot be resolved and experience so far has shown this to be a question of immense complexity, posing methodological problems and evaluation that are difficult to overcome.'*

That's the challenge that the Nosokinetics agenda seeks to overcome. For the unintended consequence which followed on in the years that followed is that few physicians in geriatric medicine have any responsibilities for long term care. And the face of the specialty has changed from a 'bottom up', community supportive service, solving 'bed-blocking' in acute hospitals to an acute admission service specialising mainly in stroke illness, falling and Parkinson's disease.

### References

- Department of Health (1981). Report of a study on the respective roles of the general acute and geriatric sectors in the care of the elderly hospital patient. ISBN 0-902650-34-3, Department of Health and Social Security: London.
- Millard, P. H. and C. S. Smith (1981). "Personal belongings - a positive effect?" The Gerontologist **21**: 85-90.
- Millard, P. H. (1991). The Bolingbroke Hospital long-term care project. Chapter in Care of the long-stay elderly patient. M. J. Denham. London, Chapman and Hall: 283-298.
- Millard, P. (1997). The Bolingbroke Hospital long-term care project. Chapter in Continuing Care for Older People. M. J. Denham, Stanley Thorne Ltd.: 323-337.

## Measuring and understanding what counts – what the workers do

By Mark Mackay and Pam Castle.

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Australia, like many developed countries, faces considerable health workforce challenges in the short to medium term. This arises from a number of factors, including the ageing of the workforce, low fertility rates, increasing levels of chronic disease across all age groups, and a current jobs boom.

The Building Better Work (BBW) methodology was developed during 2007 to enable the capture of novel data about the health care workforce. The process captures detailed observational data relating to health care workers (professional and support workers) using a simple electronic tool – a tablet computer. The observational approach enables capture of data relating to the work being undertaken as well contextual information and relies upon a rigid job analysis taxonomy that currently relates to Australian acute care hospitals, and a flexible work variable setting.

Information generated from this process is powerful – it enables workplace anecdotes about the issues facing the workforce to be quantified and facilitates the development of solutions to these issues. Functional job analysis provides the theoretical underpinning for the rigid task taxonomy. Functional job analysis has its roots in organisational psychology.

The methodology has the potential to be applied to investigate additional health workforce issues (or it can be further developed for application in alternative industry settings). The process can be used to obtain the data and information in the box.

The observational approach, combined with the e-approach, has several advantages over conventional survey techniques, including

- The ability to capture fine level data
- The ability to capture clean data (and remove the need for transcription of hand written documentation)
- The ability to capture data on more variables and in more detail
- The ability to undertake temporal analysis, and overcome the discrepancies associated with self reporting and surveys.

There are a range of possible projects that may be of interest to students. From smaller projects suited for honours or masters students to more in-depth studies suited for PhD studies e.g.:

1. Validation of the tool for use in studying allied health or nursing workers.
2. The use of the BBW process to investigate work in different industries.
3. Application of the BBW methodology to investigate:
  - i. Health worker related issues such as the relationship between busyness and stress.
  - ii. The impact of breaks or interruptions on workers, and
  - iii. Novel or researcher instigated issues (though clearly relevant to the project)

The data collection methodology can be used to facilitate the improved collection of data for other types of projects, particularly those involving the study of patient flow. For details regarding this potential please contact the authors.

<https://www.library.health.sa.gov.au/Portals/0/building-better-work.pdf>

Competing interests: The authors are developers of the Building Better Work methodology

Better data



Improved understanding



Better decisions & outcomes

### Building Better Work

#### Workforce Development

- Job sizing
- Performance measures
- Job description matching to actual work performed
- Training time and activities
- Protected time
- On-call and call back frequency
- Research opportunity
- Professional development

#### Role Redesign

- Task duplication
- Potential task reallocation
- Skill set match to work dimension
- Job sharing implications
- Job satisfaction factors
- Workforce planning and gap analysis

#### Service Planning

- Scenario planning
- Skill mix required to deliver a service
- Unit planning- function : resources
- Comparisons across units / systems
- HR staffing scenarios
- Efficiencies Analyses
- Cost analysis by role : task / service

#### Evaluation

- System efficiencies / context
- ICT
- Workforce scenario planning / costing e.g.
- Physician Assistants
- Allied Health Assistants
- Less/more administration support
- Impact of team instability

#### Safety and quality

- Work patterns
- Task frequency and duration
- Interruptions to workflow
- Work intensity
- Seasonal fluctuations
- Rostering and scheduling
- Information transfers

## National Institute for Health Research (NIHR).

NHS partners needed for Academic research applications

### Research for Innovation, Speculation and Creativity (RISC) Project Scheme

The aim of this scheme is to provide research of direct benefit to users of the NHS in England. The RISC programme is for potentially paradigm-changing projects in Health Services and Public Health Research. The maximum grant will be £100,000 per project. At full capacity NIHR intend to make 50 awards each year. Awards will normally be for 12-18 Months in duration.

Closing Date: 29 April 2008

<http://www.nihr-ccf.org.uk/site/programmes/risc/>

### Research for Patient Benefit (RfPB) Programme

The the RfPB scheme is to support projects in Health Services Research and Public Health. Projects can be either quantitative or qualitative, and should aim to: - study the way that NHS services are provided and used - evaluate whether interventions are effective and provide value for money - examine whether alternative means for providing healthcare would be more effective in terms of cost and effectiveness - formally assess innovations and developments in healthcare.

Projects supported will normally be up to 36 months in duration with a total maximum cost of £250,000.

Closing Date: 08 April 2008

<http://www.nihr-ccf.org.uk/site/callsproposals/rfpb/default.cfm>

Wells, R. and J. A. Whitworth (2007). "Assessing outcomes of health and medical research: do we measure what counts or count what we can measure?" *Aust New Zealand Health Policy* 4: 14.

<http://www.ncbi.nlm.nih.gov/pubmed/17597545?dopt=Citation>

Concludes academic metrics of research output through peer-reviewed publications and citations are insufficient to satisfy society's expectation that public investment in research results in benefit to society. This is particularly the case for Health and Medical Research. An approach that takes into account all the benefits of research outcomes, including the freeing up of resources from savings on treatments and other costs, needs to be taken. This approach will require new metrics which are understood and accepted by society and the governments which represent it. It is no longer enough to measure what we can - we need to measure what matters.

Amen to that. But what about the research we are doing, but little of which is directly funded? Answers on a email postcard please.

#### DON'T WANT TO / CAN'T AFFORD IT

#### THE FUTURE OF OLD PEOPLE'S MEDICAL CARE IN THE NHS: COVENANT TO CONTRACT

Monday 25 February 2008, Lower Atrium Theatre,

The Royal Society of Medicine, 1 Wimpole Street, London, W1G 0AE

- |         |   |
|---------|---|
| 5.00 pm | Registration with tea and coffee  |
| 5.30 pm | <b>Introduction from the chair</b><br><i>Ros Meek, President of the Open Section</i>  |
| 5.40 pm | <b>Can't Afford to: Don't Want to: Government Policies for Pensioners Care</b><br><i>Joseph Harris, General Secretary of the National Pensioners Convention</i>   |
| 5.55 pm | <b>Means Testing and the Bio/Psycho/Social Model of NHS care</b><br><i>Dr Chooi Lee, Consultant Physician, Kingston Hospital</i>  |
| 6.20 pm | <b>Health and Social Care Systems: Symbiosis or Parasitism</b><br><i>Prof Peter Millard, Emeritus Professor of Geriatrics, St. George's, University of London.<br/>Visiting Professor, HSCMG, University of Westminster</i> |
| 6.45 pm | Discussion  |
| 7.20 pm | <b>Close of meeting</b>   |

Contact me if you would like to come as a guest [pmillard@tiscali.co.uk](mailto:pmillard@tiscali.co.uk)

## **Westminster University: School of Informatics**

Organised by Professor Thierry Chausalet and Professor Paul Harper

All seminars are co-sponsored by the IEEE UKRI CAS and I&M Chapters.

### *Special Event - Data Mining Applications - Open Lecture Series*

Monday, 11th February 2008. 16.45—18.00 Small Lecture Theatre

Prof Paul Harper, Cardiff University

*TreeFit: the development and application of a powerful decision tree data mining tool.*

*this is a joint event with the Operational Research Society Health and Social Services Special Interest Group*

Monday, 18 February 2008, 18:00-20:00, C1.04

John Spooner, Analytics Product Manager, SAS

*UK Using data mining to gain a competitive advantage (title tbc)"*

Monday, 25 February 2008, 18:00-20:00, C1.04

Dr Simon Jones, Head of Analytical Services, Dr Foster Intelligence Ltd. "

*Data mining Tools at Dr Foster Intelligence (title tbc)"*

Monday, 3 March 2008, 18:00 – 20:00, C1.04

Erich Teichmann, Technical Director, BT Global Services

*Architecting a Data Mining Solution (title tbc)"*

Monday, 10 March 2008, 16:45 – 18:00, Small Lecture Theatre

Prof Peter White, Transport Studies Group, School of Architecture and the Built Environment (SABE), University of Westminster "

*The use of data from smart card systems in public transport "*

**Valediction** We thank Roy Johnstone and IMS for the valuable support given to us in the development of the index of papers and a URL supported newsletter. With Roy's guidance I learnt a lot and he showed me us how a URL supported newsletter could work. However, the double act in developing two styles was time consuming and is unsustainable. So this issue and future issues will only be available in pd.f. website on the [www.nosokinetics.org](http://www.nosokinetics.org) website. The online archive created by Roy will be kept on the IMS website at <http://www.iol.ie/~rjtechne/millard/index>

## **Nosokinetics News is the newsletter of the UK Nosokinetics Group**

Nosokinetics is the science / subject of measuring and modelling the dynamic aspects of patient and client movement (flow) through health and social care systems. From the Greek, literally, *noso* (sickness) and *kinetics* (movement).

The group collaborates to organise conferences and disseminates news of our and others research and practical use of modelling to enhance decision making in health and social care systems.

Past issues in PDF at <http://www.nosokinetics.org/>

Thanks to IMS our web archive of full texts of submitted papers between 2006-2007 is at: <http://www.iol.ie/~rjtechne/millard/index0.htm>

To receive a personal copy follow the instructions at

<http://www.jjscmail.ac.uk/lists/NOSOKINETICS-NEWSLETTER.html>

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### **Officers of the Nosokinetics Group:**

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