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Nosokinetics News

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In this issue: Revlin Abbi from Elia ElDarzi's group at Westminster describes data mining that reveals four normally distributed groups of stroke patients in the English national data set. Nigel Edwards, plenary talk at the IMA conference, considers present problems and future challenges for modellers of health and social care systems. Old physics or new physics: what way should we go? Answers on a post-card please (email will do). Finally, a special issue call, make a note in your diary for Portrush 18th and 20th March 2008, and look at the logo.

Where too next? Charting the way forward: only fools succeed

A lead from a Professor at the Cairo Conference led me to read Simon Singh's "The Code Book. The secret history of codes and code-breaking" (Fourth Estate, London, 2000). Three quotes about the history of code-breaking summed up for me the current status of the Nosokinetics endeavour.

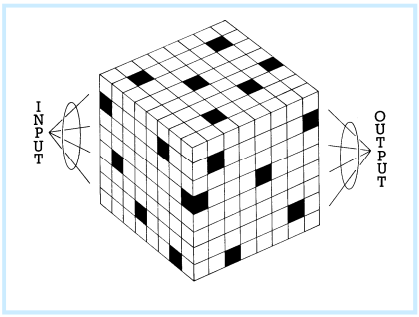
The Ostrich Syndrome

Charles Babbage, (1830's) designer of the first mechanical computer

'Propose to an Englishman any principle, or any instrument, however admirable and you will observe that the whole effort of the English mind is directed to find a difficulty, or an impossibility in it. If you speak to him of a machine for peeling potatoes, he will pronounce it impossible: if you peel a potato with it before his eyes, he will declare it useless, because it will not slice a pineapple.' (opus cit p 64)

Opening the black-box: waves of patients

'Interest in hieroglyphics was reawakened in the seventeenth century, when Pope Sixtus V reorganised the city of Rome according to a new network of avenues, erecting obelisks brought from Egypt at each intersection. Scholars attempted to decipher the meanings of the hieroglyphs, but were hindered by a false assumption: nobody was prepared to accept that the hieroglyphs could possible represent phonetic characters, or phonograms, The idea of phonetic spelling was thought to be too advanced for such an ancient civilisation.' (opus cit p 204)



Only fools succeed

Martin Hellman, speaking about Ralph Merkle

'Like us, Ralph was willing to be a fool. And the way to get to the top of the heap in terms of developing original research is to be a fool, because only fools keep trying. You have an idea number 1, you get excited and it flops. Then you have idea number two and it flops. Then you have an idea number 99, you get excited, and it flops. Only a fool would be excited by the 100th idea, but it might take 100 ideas before one really pays off. Unless you are foolish enough to be continually excited, you won't have the motivation, you won't have the energy to carry it through. God rewards fools. (opus cit p 256)

Footnote: In 1974 Mrs Williams, a friend of my mother drew the Ostrich Syndrome pictures for a tape slide presentation, we made at St. George's Hospital for the Health Advisory Service, to illustrate the benefits of teamwork and specially designed environments in the medical care of old people. The box was drawn in 1988 by Anthony Burgess my wife's sister's son. So do the obsessed involve others in their plans.

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Mining length of stay data for better understanding patient flow

Revlin Abbi, PhD Candidate, Harrow School of Computer Science, University of Westminster
(comments to abbir@westminster.ac.uk)

Data mining is the process of extracting knowledge from large volumes of historical data to discover patterns in the data that help explain current behaviour or predict future outcomes. Classification is a branch of data mining, which enhances understanding by extracting information to make predictions about the future. Classification distributes objects into groups of similar type. In our case, we wish to distribute records representing patient spells, into non-overlapping, mutually exclusive length of stay (LOS) classes, where each class represents a LOS interval range. To achieve this aim we are working on developing a patient spell classification methodology.

The methodology classifies patient spells according to the patient LOS variable. Based on the classification, a model is derived that can be used for both descriptive and predictive purposes. The model is descriptive as it extracts specific and unique characteristics (profiles) for each LOS class. It is also predictive as we hope to make it is generic enough to correctly predict the LOS of unseen or future patient admissions.

A two-stage process. Stage one fits a Gaussian mixture model (GMM) to discover LOS groups that are probabilistically defined and thus tend to overlap with one another. Stage two derives LOS classes from the LOS groups (using the Bayes theorem). The GMM is a probability density model consisting of a mixture of normally distributed component functions. Given the right number of component functions, the GMM is capable of approximating the skewed LOS distribution.

Figure 1shows that a five-component GMM can be fitted to a data set of stroke patients. From the estimated GMM parameters, we derive the mean, variance and percentage of patients belonging to each LOS group. The mean indicates the expected stay and the variance to describe the homogeneity (variation) within each group.

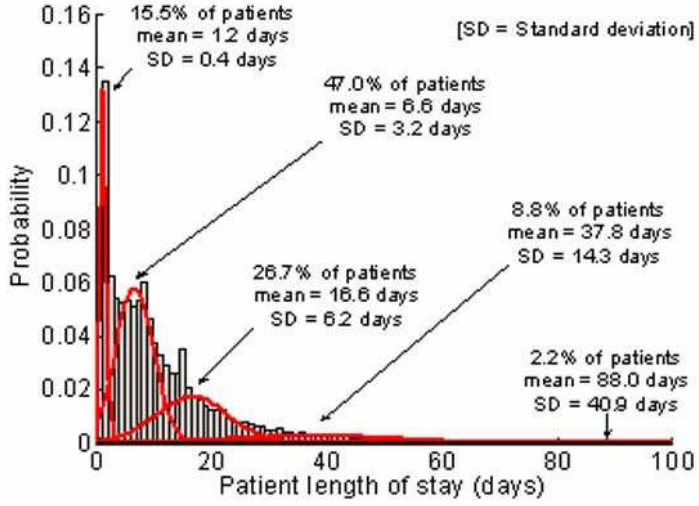

Figure 1. Five component GMM of Stroke patient LOS

percentages determine how many of the admitted patients are likely to have short, medium or longer stays. Based on the GMM in Figure 1, the five classes are defined as 01-02 days, 03-12 days, 13-29 days, 30-70 days, and 71+ days. Once the GMM is fitted and the classes are defined, we extract a mapping that differentiates patient spells according to the derived LOS classes.

Mapping is represented in the form of a decision tree, in other words a graphical representation of a set of rules. To estimate future prediction performance the decision tree is applied to a set of unseen patient records. In this case, the performance measures are used to indicate how well the tree is likely to perform. The tree can then be used, with confidence, to classify future patient admissions into the most likely LOS class.

In summary, the proposed methodology provides an innovative approach to classifying patient spells according to their LOS. The approach provides a simplified representation of the patient population, which may help to improve the planning and management of patient care.

Full text http://www.iol.ie/~rjtechne/millard/nsk73/abbi73.htm

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Opportunities and challenges for modellers in NHS reforms

Nigel Edwards, Policy Director, The NHS Confederation, 29, Bressenden Place, London, SW1E 5DD, kindly enabled us to use his IMA conference slides to craft his opening talk at the IMA Conference.

Government is changing the NHS from a professionally led system, with top down planning, to a more flexible management system where the patient is in control. The move towards a Primary Care Trust system involving health and social care increases the need for the development of appropriate modelling tools.

Targets, though achieving their purpose are now recognised to have distorted the system. The reform agenda, seeks to increase patient choice and quality of care through payment by results, new contracts, plurality of provision, autonomous providers, new providers and practice based commissioning choice.

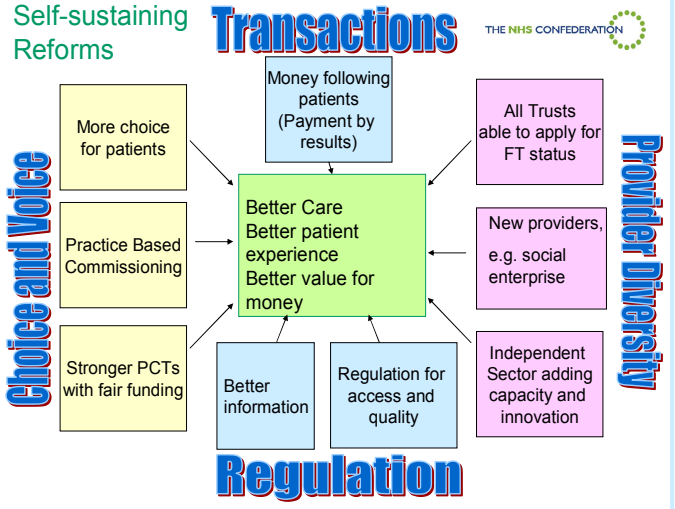
Box 1 shows the changes being made and Box 2 figure shows the theory that underpins the change. Up and coming issues concern safety and quality outcomes and experience, and efficiency and cost reduction.

Frontline systems will increase the use of guidelines, systematic approaches and the need to understand variation and the implications of how systems work. Anticipatory care will increase, as will interest in risk protection and issues concerning safety and reliability. Also interest in statistical process techniques and special and common cause variation will increase.

A characteristic of clinical processes is that they are often complex, non-standard and dynamic. Thus the nature of illness and the consequent use of shared resources raises issues of concern. For many of those running the systems have faulty conceptual models and limited access to tools.

Box 1: Changing the National Health Service

From	To
Top down management	Contracts and regulation
Targets	Standards
Interested in process	More focus on quality
Financially opaque	Transparent
Historic funding	Activity related
Provider led	Payer and patient led
Hospital focussed	Care closer to home



Box 2: Theory underpinning NHS changes

Nigel listed many problems that need to be overcome.

- Using averages
- Failing to understand the nature of distributions
- Static models for dynamic problems
- Bed modelling
- Failing to measure demand
- Using capacity as a proxy
- Failure to distinguish between different work streams
- Systems based on dealing with rare events
- Inappropriate carve out

- Lack of attention to feedback & interaction
- How does behaviour change?
- Substitution effects
- Batch and queue mindsets
- Continuous flow based on pull techniques required
- Costing methods
- Confusing average and total costs
- Confusing marginal with notional total savings
- Failure to understand the opportunities in non-value adding work

Seems that health and social care modellers will be in business for many years to come. PHM 06/07

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Measuring and modelling hospital care: old or new physics

In this article I use six-line models and Ouspensky's 1931 analogy between old and new physics to consider the different ways of measuring time in moving systems. In the following three issues Mark Fackrell from Melbourne will discuss the concepts that underpin phase type models.

Einstein's conundrum

When he was a young man, Einstein asked himself :

"What would I see if I were travelling along at the speed of light?"

He answered himself:

"I will see the light waves going up and down.".

We travel through hospitals at the same speed as the patients. We know that patients flow through hospitals in streams, for terms like slow stream rehabilitation are used to describe a certain type of care. However, we are moving in time at the same speed as the inpatients. Could Einstein's conundrum explain why we simply measure the patients coming in and out?

Waves of patients

In the eighteenth century Thomas Young observed that light shone through a slit created stripes of light and dark. Watching the interactions between the high and low waves of flow behind two ducks (on the river Cam) Young also deduced that light had both particles and waves.

Physicists now know, if they measure the waves they don't find the particles and, vice versa, when they measure the particles they don't find the waves. But we can, as Gary Harrison said when he was creating the mathematical solution to a two compartmental model of flow:

"We have an advantage over pharmacologists because we know when every molecule (patient) arrives."

Order within disorder

Figure 1, from my 1988 MD thesis, shows by ordering and reordering a time series of events we can get different insights into the process of inpatient care. Four states can be seen:

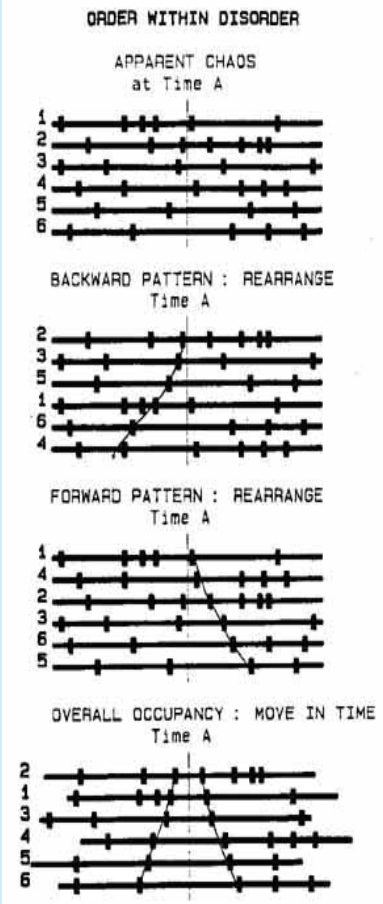

Figure 1: Order within disorder. Reorganising a sequence of disordered time related events gives order regarding backward, forward and overall events.

1. **Apparent chaos.** Six lines, 33 events. Each line (bed) with a different time related sequence of events. i.e. the scene when one starts a ward round.
2. **Backward pattern.** Rearrange the sequence of present events and plot the time the time elapsed since admission, i.e. the pattern used, subconsciously, in the post-take ward round when the current status and future prospects of each patient is discussed .
3. **Forward pattern**: Stand still in time and plot the time when the current inpatients leave.
4. **Overall occupancy.** Shuffle the pack and make the mid point of each patients stay the same.

Time is the fourth dimension of apace

Everything we see is in the fourth dimension of space. But time itself has three dimensions. Everything present was created by events and decisions made in time past. How we interpret the current scene depends on a whole host of factors, our knowledge and past experiences. The fifth dimension of time is the decisions made in past time that created what we see and how we interpret it. And the sixth dimension is all the other decisions that could have been made in time past which would, for better or worse, have created a different picture.

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Perhaps to make it clearer. Consider you have lost your way in a city. The fourth dimension question is 'Where are we?" The fifth dimension question is "How did we get here?" The sixth dimension question is "Where would we be if we had t turned left or right at the last junction?

Clinical trials: the fatal flaw

The fatal flaw of basing policy decisions on random allocation controlled trials is that the mathematical approach compares a fourth dimension problem with a fifth dimension answer. The implication being that the fifth dimension answer is preferable too and better than all other actual and potential 6th dimension methods of improving the outcome of care.

Moreover, in random allocation clinical trials, unlike placebo controlled drug trials, the staff and patients know the outcome that is expected. Hence the prophecy has its own fulfilment and no-one should be surprised that the new approach is statistically different from the old. To solve the problem we need to harness the power of modern computers to escape from old physics and embrace new methods of measuring and modelling the process of care.

Old and new physics

In 1931 P.D. Ouspensky, a Russian mathematician and philosopher outlined the differences between old and new physics. (Table from Arkana London1984 English translation 'A new model of the universe').

OLD PHYSICS	NEW PHYSICS
Geometrical conception of space, that is, consideration of space apart from time.	Attempts to escape from three-dimensional space by means of mathematics and metageometry. Four coordinates.
Conception of space as emptiness in which there may or may not be "bodies".	Recognition of velocity of light as limiting velocity. Velocity of light as universal constant.
One time for all that exists. Time measurable: on one scale.	Definition of fourth coordinate in connection with velocity of light. Time as imaginary quantity.
Elementary under standing of measure, measurability and incommensurability. Measures taken for everything from outside.	Recognition of necessity for taking time together with space. Space-time four dimensional continuum.
Recognition of a whole series of concepts, difficult to define, such as time, velocity, etc., as primary concepts requiring no definition.	Attempts to build systems of absolute units of measure.
Tendency to interpret all phenomena of radiant energy by undulatory vibrations.	Principle of increase of energy and mass of body in motion.
Necessity of hypothesis of "aether" in some form or another. Aether as substance of greatest density and aether" (community) as substance of greatest rarity.	Special and general principles of relativity; and the idea of necessity for *finite* space in connection with laws of gravitation and distribution of matter in the universe.

Conclusion

There is an uncanny relationship between the principles of old physics and current methods of measuring inpatient activity. Emptiness. One time for all that exists (midnight in UK, 8.00 am Australia). Elementary understanding of measure and measurability (averages of skewed distributions) Measures taken for everything from outside (annual statistical returns). Recognition of a whole series of concepts, difficult to define such as time, velocity, etc. primary concepts requiring no definition fell. In the 1987 reading the above I realised that I had to reject Newtonian concepts of pressure and force and seek answers to the rise and fall of my department in new physics. The rest is history.

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Call for Papers: *Interfaces* Special Issue. Deadline: 15th September 2007

Applications of Management Science and Operations Research Models and Methods to Problems in Health Care

Editors: Michael Carter, Bruce Golden & Edward Wasil

Success stories in applying MS/OR models and methods to actual problems in health care. Success stories could be tool oriented, such as describing a simulation model for patient flow, or focused on strategic, policy-level applications, such as deciding where a government should allocate its health-care funds and how it should distribute its resources. Benefits obtained and lessons learnt need to be specified. A verification letter from relevant organization is essential.

Interfaces Instructions to Authors at http://interfaces.pubs.informs.org/guidelines.htm. Papers must be submitted online using Manuscript Central at http://mc.manuscriptcentral.com/inte All papers will be refereed. Further information: carter@mie.utoronto.ca

Looking for data?

The Trends in Health and Aging site (www.cdc.gov/nchs/agingact.htm) is a comprehensive source of information about the health status, health behaviors, health insurance coverage, health care expenditures, and the use of health services by the aging population in the U.S. It is maintained by NCHS and is supported by the National Institute of Aging of the National Institutes of Health.

Solve the conundrum. How many overnight beds do Australian Hospitals need?

The Australian Institute of Health and Welfare (AIHW) report, *Australian hospital statistics 2005-06*, is now available at http://www.aihw.gov.au/publications/index.cfm/title/10455.

Bed numbers decreased. During 2005-06, Australia had 1,291 public and private hospitals, with almost 82,000 available hospital beds. Public hospital bed numbers decreased by 0.9%, to about 54,600, and private hospital beds increased by 3.0%, to about 27,200.

Hospital admissions to both sectors increased by 4.2% from 7 million in 2004-05 to 7.3 million in 2005-06. public hospitals admissions increased by 4.5% and private admissions by 3.3%.

Days Australians spent in hospital was 24.3 million, 2% higher than in the previous financial year.' said Mr George Bodilsen of the Institute's Hospitals Unit.

Same-day hospital admissions increased between 1996-97 and 2005-06 rose from 45% of admissions to 55% i.e. a 1% increase each year. Now, almost half of admissions in public hospitals and 64% in private hospitals are day patients.

Average stay for all admissions fell by 21% between 1996-97 and 2005-06, from 4.2 days to 3.3 days i.e .by 2% a year, however.

Inpatient stay remained fairly constant: In 2005-06, 6.3 days in public acute hospitals and 5.4 days in private hospitals.

PhD's on the web

Much of the research associated with the development of new methods of measuring and modelling health and social care systems is in doctoral theses or in Operational, Mathematical or Computational journal and Conference proceedings. To facilitate understanding of the doctoral research that underpins the Nosokinetics endeavour began, we seek to create a doctoral archive on the web. With this in mind I have been working to put my 1992 PhD thesis onto the web.

The research was a bed census and clinical practice study in thirteen departments of geriatric medicine to validate the Harrison two compartment model. Thousands of facts were collected, however only three correlated with the speed of treatment of short stay patients: consultants opinion re ease of discharge to nursing homes, number of patients coded for discharge to nursing homes and the nurses opinion regarding rehabilitation. With several caveats admission policies, staff levels and facilities were not the major cause of differences in length of stay.

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Second International Health and Social Care Modelling Conference (HSCM 2008)

Portrush, Northern Ireland
18 — 20 March, 2008

The first International Health and Social Care Modelling Conference of the Nosokinetics Group, at the University of Adelaide in April, 2006 provided a unique opportunity for researchers and practitioners to meet, exchange ideas, examine the current modelling trends and issues, and develop new solutions and research directions to ultimately, improve patient and client care.

The Second International Health and Social Care Modelling Conference (HSCM2008) organised by the University of Ulster will take place from 18th-20th April 2008 in Portrush, Northern Ireland. Portrush is a small seaside town on the North Coast of Ireland, with beautiful beaches, convivial restaurants and friendly pubs. It is close to the Bushmills Distillery and Giant's Causeway and part of the Causeway Coast Area of Outstanding Natural Beauty.

For further details contact Sally McClean (si.mcclean@ulster.ac.uk)

Modelling in Healthcare Stream of The Operational Research Society Conference

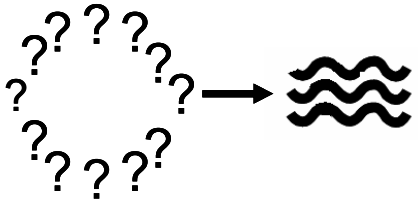
Edinburgh on 4th - 6th September

http://www.orsoc.org.uk/conference/papersubmission/conference_submit.asp?cid=14

Logo

Alan Morris, a medical colleague from my student days, on the same dissecting table, wrote:

> *'Peter, I suggest a Symbol for Nosokinetics which is a circle of question marks, then a horizontal arrow to the right of that circle followed by a few wavy lines, three or four above each other, like the sea. It represents all of your enquiries that fell into the smooth flow of implementation.'*



Here with my attempt to draw it. Other attempts or suggestions gratefully received.

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* (disease) 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. Our next International conference will be in Portrush, Northern Ireland in 18th-20th March 2008.

To join or leave our JISC mailing list copy the link below and follow the instructions at

http://www.jiscmail.ac.uk/lists/NOSOKINETICS-NEWSLETTER.html

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The web archive of full texts of submitted papers is at http://www.iol.ie/~rjtechne/millard/index0.htm

Email address for submissions, letters— editor@nosokinetics.org