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WHY HEALTHCARE PROFESSIONALS ARE SLOW TO ADOPT MODELING AND SIMULATION

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ABSTRACT

This panel session is designed to explore the reasons why healthcare fails to adopt simulation and modeling techniques, and will seek to highlight ways towards greater adoption. The aim of the panel is to have a sustained dialogue with and amongst the audience. The agenda for the discussion will cover care delivery in a variety of contexts, including, the US and UK, hospital based and in more distributed systems and operations and workforce management. It will also address the use of computer games in simulation and modeling, frameworks within which simulation modeling may best be accomplished and the steps needed to overcome barriers in each community needed to see a greater uptake of simulation modeling in healthcare.

1 INTRODUCTION

Although there are nearly 200,000 journal papers on the simulation or modeling of care delivery processes, and 30 more appearing each day (Brailsford et al. 2009b), there is a surprising lack of adoption. This panel session addresses the reasons why medical doctors, as a community, are so unlikely to adopt such methods.

This team reports on the literature, finding that 5.3% of papers describe a real implementation of a model or its findings. Meanwhile Jahangirian et al. (2010), in a paper the originates from the same program, note that in healthcare only 8% of the literature represents ‘real problem-solving articles’ (as compared to 39.4% in defense and 49.1% in commerce). This is nothing new, and the conclusions fit with earlier reviews:

> *‘Despite the increasing numbers of quality papers published in medical or health services research journals we were unable to reach any conclusions on the value of modelling in health care because the evidence of implementation was so scant’* (Fone et al. 2003);

and

> *'Despite the upward trend of health care simulation studies and the integration of discrete-event simulation and optimisation techniques, there is still a void in the literature focusing on complex integrated systems'* (Jun at al., 1999).

Moreover, Gunal and Pidd (2010) note that, against a rising number of papers, there is a lack of generic, or reusable models.

Given the longevity of the problem, it is not surprising that many people have proposed solutions. Harper (2002), for instance, proposes a framework, while Naseer et al. (2010) offer a web-based interface to help practitioners select an appropriate modeling method. Brailsford et al. (2009a) approach indirectly by addressing the question of stakeholders. However, the problem of non-adoption remains.

This panel session follows a similar, successful panel session last year, again posing the question of why simulation and modeling have failed to be taken up by clinical communities. In this case, the panelists are two doctors who are both very sympathetic to the use of simulation and modeling.

2 THE PANEL

Dr James Fackler has pursued operational research and the use of simulation and modeling within the hospital and is intrigued by the potential of mathematical flow models that describe the flow of patients. Approximately half the surgical patients have been scheduled ahead of time, enabling resources to be allocated and prepared in advance, while the remaining fifty percent are emergency cases. A model that addresses capacity, variation, and the way in which the system is connected up internally, would provide a means of improving the scheduling of patients and staff, along with the overall efficiency of the organization.

Dr. Fackler is also interested in applying data and mining techniques to the operating room and intensive care unit. Here, the challenge lies in the complexity of data sources – with each patient having 300–350 associated data feeds – and in interpretation, especially in the management of critical situations. The challenges here lie in structuring the information in to a manageable number of data themes that the brain can manage – studies have shown that the human brain can comprehend 7 quanta of data at once. This opens up interesting prospects for modeling and optimizing information flows.

This combination of real-time and strategic interests places Dr Fackler in an unusual position to contribute to a general debate in this field.

Dr Julie Hankin is a consultant psychiatrist and clinical director for service improvement at Avon and Wiltshire Mental Health Partnership NHS Trust. She has been a clinical director for six years and has wide experience of leading large scale service redesign and implementation of trust wide improvement programmes, in particular the new Payment by Results in mental health. From 2008-2009 she was a Health Foundation Leaders for Change award holder and is a member of the SW quality and safety expert faculty in addition to regional and national clinical leader networks. She has an interest in implementation science and the use of research evidence in service improvement.

She is responsible for improvement in a specialist mental health provider trust providing services to a population of approximately 1.6 million across the geographical areas of Bristol, Wiltshire, Swindon, Bath and North East Somerset, South Gloucestershire and North Somerset. The Trust employs approximately 4,000 staff and provides general adult secondary psychiatric services, memory clinics and older adults services, low and medium secure forensic psychiatric services, specialist rehabilitation, eating disorder and mother and baby services, acute and primary care liaison services, specialist drug and alcohol services and inpatient learning disability services. The major current challenges are whole system service redesign along care pathways to meet the QIPP agenda and NICE compliance and the implementation of payment by results throughout the mental health system.

Her interests in simulation and modeling are to support planning and service provision, as well as the application and development of appropriate metrics for managing care delivery.

Professor Terry Young has been Chair of Healthcare Systems at Brunel University for 11 years, following a 16½-year career in industry, which started in broadband research and led in the end to healthcare strategy. His experience of mathematical techniques includes finite element modeling (of photonic devices and optical circuits) and fast-Fourier transform-based methods for modeling the propagation of light. More recently, he has been involved in simulation modeling and a range of health-economic methods to assess the value of technology.

He is the Principal Investigator of the MATCH program, a 10 year collaboration between four universities in the UK, focused on value in health, and is currently helping to lead the Cumberland Initiative, a wider collaboration of healthcare OR interest in health.

3 TOPICS FOR DISCUSSION

JF writes:

Last year at this meeting, Michael Spaeder and I argued the two main reasons why modeling and simulation is not embraced by physicians are (Fackler and speeder, 2011):

- our collective background in mathematics is woefully lacking and,
- modelers have not yet chosen the right strategy and domain.

The discussion focused heavily on whether physicians can be compelled to use patient specific models and the best I could do for an answer was to suggest the physician community must 'get over it.' That was, of course, a rather inadequate response.

This year, I will argue that to get the physician community 'over it,' they must first be shown that a simulation accurately reflects the current state and perturbations to the simulation accurately reflect what the physicians expects from those perturbations. The SimCity™ game is now about 30 years old and even on early versions could create (if the gamer so chose) realistic representations of current cities and within those cities simulated inhabitants could be created with realistic (i.e. recognizable as plausible) behaviors.

I believe, in no small part because it is my clinical domain expertise, the intensive care unit (ICU) within a hospital is the right domain for modelers to focus. The comment that American healthcare is on an unsustainable resource consumption trajectory is voiced so frequently it now seems trite. In 2005 care of the critically ill consumed 4.1% of all national healthcare expenditures. This amount translated to 0.66% of the entire U.S. gross domestic product (GDP) (Halpern, 2009). Other countries consume far lower proportions of their respective GDP, but consumption in ICUs is still substantial. Many of these costs are believed to be wasteful and are not justified by improved patient outcomes. Adding to concerns of cost and potential patient harm, is the fact that the multi-professional critical care labor pool appears inadequate to meet the growing needs of an aging population (Krell, 2008).

The strategy should be SimCity™-like with recognizable geographies, equipment, clinicians, support staff and patient behaviors. Rather than beginning with a patient level focus, modeling would better start focused at the ICU level. As with SimCity™, the clinicians should be able to manipulate characteristics of the environment (e.g. seasonal patient load fluxes (Spaeder and Fackler, 2011), management of operating room schedules, clinician availability etc.) and see in simulation outcomes that match an expectation. Of course, the coup de grâce would be a reality-based implementation of culture or workflow changes that produce outcomes predicted by the simulation.

Certainly patient acuity of illness plays a central role in the throughput and workflow in an ICU. Therefore, increasing the modeling complexity at the patient level will increase the fidelity of the high-level ICU model. There is a strong literature on the relationships between patient acuity and nursing workload (Padilha et al. 2007) and, of course, there is a relationship between patient acuity and critical care resource utilization (e.g. length of stay) in both adults (Zimmerman et al. 2006) and children (Pollack et al. 1988). So to tie these thoughts back to the beginning, first we should generate clinician comfort that modeling can reflect reality and only then push into deeper and deeper refinement of the characteristics of individual patients.

JH writes: Projects utilizing simulation methods that I am currently running within the trust are:

- Complex psychological therapies pathways
- Forensic personality disorder pathways
- Primary care psychological therapies pathways linked to tendering for new service
- Medical workforce modeling
- Simulation based medical leadership development program
- Development of a new employment support program partnering primary care psychology and an employment charity

I would like to use the results and experiences from these projects to discuss the challenges and opportunities of utilizing simulation methodology within frontline healthcare delivery. Harper and Pitt, 2004 and Brailsford, 2005 provide the basics of a framework initial framework to consider this. My aim is to catalyse a discussion within the modeling community, as to how this might be applied to meet the topics listed above. To shape this discussion, I would like to draw the discussion back, periodically, to the context of the significant changes to UK healthcare over the last 8 years and the possible changes in the future in particular the move to a mental health payment by results system.

The Agenda for the discussion will therefore cover the following:

- Care delivery in a variety of contexts, including:
  - US and UK
  - hospital based and in more distributed systems
  - operations and workforce management
- The interface between computer games and simulation and modeling
- Frameworks within which simulation modeling may best be accomplished
- Steps needed to overcome barriers in each community needed to see a greater uptake of simulation modeling in healthcare.

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JAMES FACKLER, MD is Associate Professor, Pediatric Critical Care Medicine, at Johns Hopkins University. He is interested in operations research within Pediatric Critical Care focused on task analyses, modeling, and redistribution of all tasks to the right provider (regardless of current historical, cultural and/or regulatory constraints). He was on the faculty of the Children’s Hospital Boston for about 10 years before returning to Hopkins. Academic interests also include data integration. He is a founding Board Member of the Virtual PICU. With medical device and physiological data he is mentoring Masters and PhD students in data visualization, pattern recognition and guideline adherence.

Dr. Fackler worked for the Cerner Corporation from 2002-2006. He was responsible for the development and deployment of the critical care solution suite. He co-founded Oak Clinical Systems; a start-up focused on a personally controlled health record with a problem-based organization. He also has a part-time executive role for Cardiopulmonary Corporation; a data integration, analytical and alarm management company.

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TERRY YOUNG, PhD studied at Birmingham University, UK for his bachelors and doctoral degrees, the latter being in atomic spectroscopy. After that he started an industrial research career in numerical modelling of photonic structures, such as waveguides, filters, switches and modulators. His later career as an academic has focused on a range of simulation and modeling techniques related to healthcare processes and the value of technology in care delivery.

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