Using operational information and information systems to improve in-patient flow in hospitals
Proudlove, N C;Boaden, R
Journal of Health Organization and Management; 2005; 19, 6; ProQuest Central
pg. 466

JHOM
19,6

466

Using operational information and information systems to improve in-patient flow in hospitals

N.C. Proudlove and R. Boaden
Manchester Business School, The University of Manchester, Manchester, UK

Abstract

Purpose – To consider how information and information systems can be used to support improving patient flow in acute hospitals (a key target for the National Health Service in England), and the potential role of the National Programme for Information Technology currently being developed.

Design/methodology/approach – The literature plus past and present research, teaching and consulting experience with all levels of the National Health Service is drawn on to consider information provision and requirements.

Findings – The National Programme for Information Technology specifies many features designed to support improving patient flows, though timescales for implementation are longer than those for the pledged flow improvements, and operational use of this type of information system has been problematic in the National Health Service.

Research limitations/implications – The work is limited to the National Health Service and information systems in use and planned for it. The National Health Service access targets, flow improvement initiatives and the National Programme for Information Technology apply primarily to England.

Practical implications – Some bed/flow management information systems currently in use incorporate tools and capabilities in advance of what is outlined in the National Programme for Information Technology, and some rare cases of culture changes in information system use have been achieved. One should learn from these to inform development and implementation of National Programme systems. These existing information systems and approaches may also be useful to hospitals considering systems prior to implementation of the National Programme for Information Technology.

Originality/value – There has been very little consideration of the use of operational information and information systems for bed/flow management in the literature. Development and implementation of National Programme for Information Technology systems should build from an understanding of the practice and context of bed/flow management.

Keywords Hospitals, Information systems, National Health Service, United Kingdom

Paper type Research paper

Introduction

The National Health Service Plan (Department of Health, 2000) laid out ambitious targets around patient access, particularly concerned with waiting times for elective procedures and for emergency treatment. Achieving these targets, and improving overall patient experience, requires improvements in inpatient flows (Cummings and Cooke, 2003) supported by effective information systems (NHS Confederation, 2003, Wanless, 2002). This paper considers the potential for information systems to support the management and improvement of in-patient flows in National Health Service

hospitals, and puts this in the context of the National Health Service Modernisation Agency and National Programme for Information Technology initiatives.

In England, the Modernisation Agency is running several programmes to help hospitals improve patient flow (Modernisation Agency, 2003, 2004) and these will be supported by the National Programme for Information Technology, which is being rolled out from 2004-2010 (Granger, 2003). However many of the key targets on patient access have to be achieved before this new generation of information systems will be in place. Current information systems are rarely adequate for supporting bed/flow management (National Audit Office, 2000) and so little use appears to be being made of operational data i.e. real-time data at the level of the individual patient.

One of the issues in improving in-patient flows is that there is not generally one function in a hospital taking an overview of the flow, or responsible for managing it from start to end. This is in contrast to a manufacturing environment, where a "production manager" would be considered an integral and essential part of the management of the organization, "operations" managers are similarly found in other types of service organisation, but are much less common in the National Health Service (Walley and Davies, 1999) although perhaps necessary (Mango and Shapiro, 2001).

The function most closely involved in this in National Health Service hospitals is usually termed bed management. It is generally staffed by senior nurses and in some cases supported by clerks (sometimes in a Bed Bureau). Some Trusts use different terms, and some bed managers (or equivalent) have considerable additional responsibilities, especially outside normal working hours. A few Trusts are starting to appoint capacity/flow managers, a logical extension from the work of the Modernisation Agency's flow-improvement programmes. There is little commonality of role or terminology (National Audit Office, 2000).

The paper starts with an outline of the typical role of bed management in National Health Service acute hospitals and the use of information in this. Following a brief summary of the main broad initiatives in flow improvement in the National Health Service, the potential contribution of information systems to bed and flow management is considered. This paper draws on contacts with a large number of acute hospitals through a national development programme for bed managers (Jorgensen et al., 2003), work with the Modernisation Agency, Strategic Health Authorities and contacts with many acute hospital Trusts.

Bed management and in-patient flow in National Health Service acute hospitals

"Bed management" encompasses both strategic and operational capacity management. Strategic issues include configuration of a hospital's bed stock, whilst operationally bed managers deal with day-to-day management of flows of inpatients through its beds. The latter aspect dominates what is termed "bed management" in most acute Trusts (National Audit Office, 2000).

Operational bed management operates in an environment of high bed occupancy and mismatched admission and discharge activity patterns over the course of the day and the week (Proudlove et al., 2003). Median occupancy in adult medicine and rehabilitation is 97 per cent (Audit Commission, 2003), making absorbing admissions (particularly emergencies) very difficult. Data from many Trusts show that daily variation in electives and discharges (activities largely controlled by health service

staff and not subject to external random variation) is actually greater than in emergencies. This setting results in less than optimal access to treatment, and unnecessarily-long lengths of in-patient stay, making the management of flows very challenging.

The pressure to accommodate emergency and elective admissions has led to a concentration on juggling the placement of admissions: bed-finding and firefighting in response to bed shortages. Many of the decisions required involve resolving conflicts, for example the competition for beds between emergency and elective admissions, and the access-time target for Accident and Emergency Departments versus appropriateness of placement. In most acute Trusts beds are (or are at least perceived to be) the resource that limits greater throughput, and little attempt is made to coordinate beds with other constrained resources such as operating theatre slots and key staff (e.g. anaesthetists).

Figure 1 shows a simplified representation of the patient journey, and the role of bed management in it, elaborating the Audit Commission's (1992) Admission-Placement-Stay-Discharge bed-management framework. This framework is conceptual; in practice the processes are sometimes not distinct, and patients can sometimes not pass through all four stages. The dashed lines in Figure 1 indicate the flows of information required for effective bed management. In most hospitals bed managers spend a considerable amount of time collecting this information (National Audit Office, 2000), for example through walking round wards, and there are particular problems in its timeliness and accuracy, relating to both technical and human factors, which limit the effectiveness of the bed-management function.

Bed management as a function has many responsibilities (Proudlove *et al.*, 2003; Boaden *et al.*, 1999):

In most Trusts bed managers:

- place emergency admissions (arriving via the Accident and Emergency Department or the Medical Assessment Unit etc., and transfers from other hospitals) into appropriate beds;
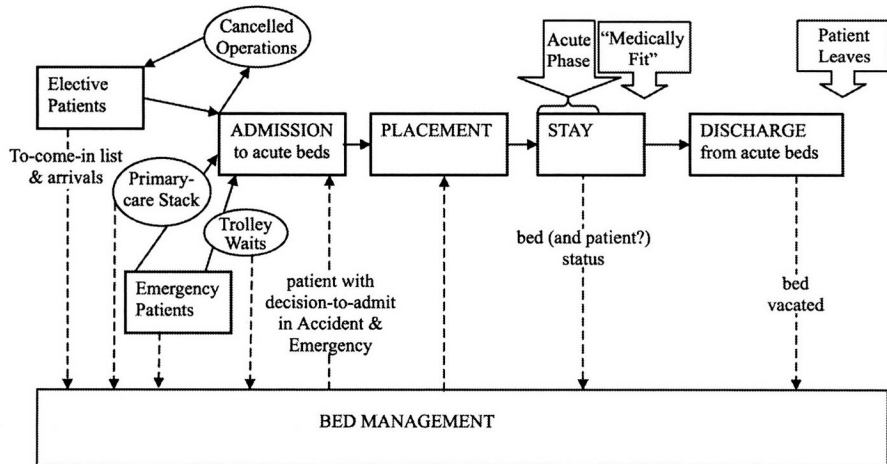
Figure 1.
Conceptual representation of inpatient journey and bed management information

- facilitate discharge (or work with discharge teams who do this) by coordinating the many services the patient may require, from the pharmacy and transport to care packages provided by agencies outside the Trust; and
- coordinate the movement of patients from assessment or admission units (e.g. the Medical Assessment Unit) to in-patient wards.

In some Trusts they also:
- handle urgent-referral telephone calls from General Practitioners;
- negotiate with General Practitioners delays to emergency despatch to hospital ("stacking");
- plan elective to-come-in lists;
- place elective admissions;
- assess the clinical risk of outlying patients (e.g. placing a medical patient on a surgical ward); and
- transfer patients to and from neighbouring Trusts.

In some Trusts bed management has access to a large bed pool consisting of most of the bed stock, whilst in others bed management is run within divisions (e.g. Medicine and one or more surgical directorates), on a site basis, or restricted by considerable ring-fencing. Despite great potential to contribute to capacity planning and crisis avoidance, in practice bed management is often characterised by bed finding, and firefighting once a crisis is occurring (National Audit Office, 2000, Boaden et al., 1999). Discussions with the bed managers currently on the Bed Management Development Programme (representing 43 hospitals) indicate there are now more staff in place, and some increased seniority compared to two years ago, but there is still a way to go and those on the programme do not feel they have enough senior influence to effect change.

The importance of information
Much operational bed management is occupied with the placement part of the process illustrated in Figure 1. This requires reconciling dynamic supply and demand in real time. Figure 2 illustrates the information about patient flows and bed configuration bed managers must juggle.

On the demand side, emergency admissions can be forecast to some extent, whether by simple techniques within the Trust such as moving averages (Proudlove and Gordon, 2002), or complex methods such as that provided commercially by the Met Office (The Met Office, 2001). However, considerable random variability overlies this and there are complex, sometimes counter-intuitive, interactions between attendance and admission (including the experience of admitting staff and the level of occupancy in the hospital). Commonly, elective to-come-in lists are assembled by consultants or their secretaries (National Audit Office, 2000). The efficiency of updating and validating to-come-in lists, and the degree of access for bed management to this intelligence, varies between Trusts.

Information about discharge can be particularly difficult to obtain. Discharges may be delayed to protect beds for potential or expected patients matching a ward's specialty ("tactical blocking" (Audit Commission, 1992)) or to control the workload of a ward (Commission for Health Improvement, 2002). This can extend to the truthfulness
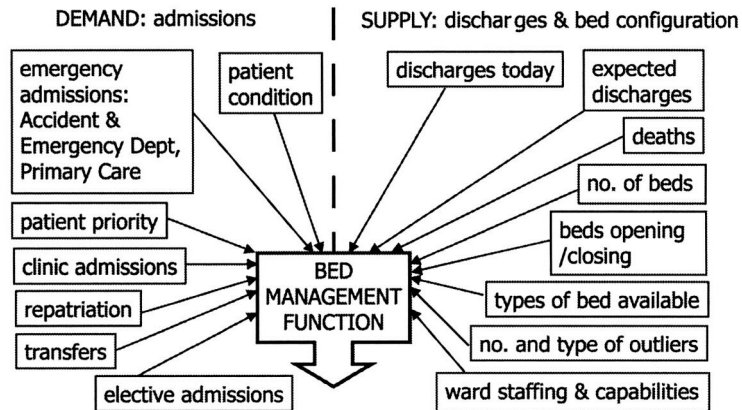
of bed states declared by wards (Boaden *et al.*, 1999). Bed-configuration information includes ward capabilities: bed numbers (permanent, temporary, closures due to infection, five-day beds opening and closing), staffing and experience, and consequent judgements about the risks of placing different types of patient on the ward.

Consequently, most (over 90 per cent in the National Audit Office (2000) survey) bed-management functions cannot rely on the hospital's information systems for bed-state information. The time lag in updating a hospital's central patient administration system can range from several hours to as long as three days (Bourke, 2003), and in some, data-extract routines are so time-consuming that it is only practical to run them once a week (Forni, 2002). So virtually all bed-management functions rely on time-consuming ward walks and telephone calls to obtain the information they need (National Audit Office, 2000).

Hospitals tend to collect and use activity data primarily for retrospective reporting. Operational staff in hospitals (such as bed managers) rarely attempt to use this activity data to analyse patterns and monitor performance. This highlights the significant fact that very few hospitals record the operational information they would need if they were to try to manage the system effectively. For example, in a commercial business (whether a private healthcare provider or a manufacturing company) the time it takes to complete a "job" (for example, length of patient stay) would be a key measure to record, monitor and analyse, and jobs managed to attempt to meet an expected due date. Indeed active management of the care process is cited as one of the factors contributing to lower length of stay in other acute hospital systems (Ham *et al.*, 2003).

Improving the management of in-patient flows

In considering bed management, and operational capacity planning in general, it is necessary to recognise that the components of the patient journey form a system, the effective management of which requires integration. For example, problems such as trolley waits and operations cancelled for lack of a bed are frequently the result of general problems at the discharge end of the process or arising from the activity patterns in emergency demand, elective demand and discharge.

Capacity is not about beds, it is about the capability of the system to admit the appropriate patients when necessary, provide the appropriate treatment in an

appropriate environment, and discharge as soon as appropriate. As the Audit Commission (Audit Commission, 2003) conclude, although most Trusts think they desperately require more beds (and some may be able to rationally justify this) most need to use their existing beds more efficiently – improving patient experience and avoiding the possibility of making performance worse by injecting more resources into a chaotic system. Some commentators believe this need not be expensive (Black and Proudlove, 2003), indeed international comparisons (Feachem *et al.*, 2002, Ham *et al.*, 2003) suggest it should be possible for the National Health Service to perform better at less cost.

There are many initiatives underway to improve bed management and patient flows in the National Health Service (Proudlove, 2004b; Proudlove and Black, 2004). Notable national education initiatives are the Bed Managers' Development Programme (run through Greater Manchester Strategic Health Authority and now entering its third year) (Jorgensen *et al.*, 2003) and the National Health Service Modernisation Agency's Bed Management Improvement Programme (Modernisation Agency, 2003) and Improvement Partnership for Hospitals (Modernisation Agency, 2004). Some of these are informed by the work of the US Institute for Health Improvement (Institute for Healthcare Improvement, 2003).

The main thrusts of improvement initiatives are:

- understanding the characteristics and interactions of the system;
- reducing variation in activity patterns;
- redesigning flows to reduce waste and increase standardisation; and
- move from "push" to "pull" through the system where possible.

A "pull" mechanism recommended nationally (NHS Modernisation Agency, 2003; Department of Health, 2003d) is to assign expected discharge dates to patients at, or soon after, admission and update them during the patients' stay. This is becoming increasingly important with changes to funding arrangements. In England, National Health Service Trusts now have a duty to inform social services about a patient's likely community-care requirements and expected discharge date, and from 2004 Trusts have been permitted to charge for delays in such transfers of care (Department of Health, 2003a). Length-of-stay-based funding for activity is being introduced, initially for a selection of elective procedures (Department of Health, 2002, 2003b), but this could be extended to activity arising from emergency admissions too. Such reforms will start to increase pressure to reduce unnecessarily long lengths of stay. Comparisons with US providers suggest there is great scope to reduce acute-hospital length of stay and admission rates, and that good information systems must be an important component (Ham *et al.*, 2003).

The National Programme for Information Technology and bed/flow management information systems

The National Programme for Information Technology seeks to integrate existing IT and information systems, and introduce new ones, rolling-out across England by 2010. The "spine" of the new technology is to be the electronic lifelong integrated care-records service. Particularly important for bed/flow management is electronic support for the integrated care pathways being developed by the Modernisation Agency, linked to the integrated care-records service, and process management

systems for sequencing, scheduling and integrating care packages. The integrated care-records service is to enable sharing of information along the whole care pathway, allowing better management of resources and auditing of care. This will aid the shift from acute to community and primary-based care (Department of Health, 2003c), to make the National Health Service more like providers in many other health systems (including in the US and continental Europe).

The specification for the National Programme for Information Technology integrated care-records service (Department of Health, 2003c) demands the following capabilities relevant to bed and flow management:

- bed type, real-time occupancy, availability, allocation, holding (for home-leave or due to come in);
- real-time patient tracking and location, originally-estimated expected discharge date, updated expected discharge date, reason for delay, responsibility for facilitation of discharge – linked to a care plan identifying actions to enable discharge;
- identification of suitable resources to meet patient need;
- close link between bed management and scheduling (departmental, enterprise-wide and across the healthcare community) which will electronically book calendar slots for necessary resources for assessment, treatment and care, and include priorities and restrictions for specific users;
- resource scheduling, viewable by resource type, integrated care pathway or facility;
- capacity monitoring and planning;
- estimation of elective bed requirements through scheduling and estimating length of stay;
- link with social care; and
- transfer of patients and information between care providers and settings.

The integrated care-records service and integrated care pathways underlying the National Programme for Information Technology vision should enable the new systems to have a clear focus on the flow of patients through the hospital system (conceptually shown in Figure 1) and beyond, and the specification above provides the capability to capture the information streams of Figure 2 in real-time. Such improved information systems will enable more effective flow management, and so may contribute to improved access (Department of Health, 2003c).

However, the long (and currently imprecise in detail) timescales of the National Programme for Information Technology systems, and the need to improve inpatient flows before it will be fully available, is prompting consideration of what can be done in the interim by developing existing information systems. For example the Greater Manchester Strategic Health Authority is drawing up recommendations for common capabilities across the nine acute hospital Trusts in its area (12 acute hospital sites). Recommended capabilities include real-time bed state, basic admissions forecasting, expected discharge date, and length of stay monitoring; plus similarity of "look and feel" between sites (and possibly with the system to be provided by the local service provider for this aspect of the National Programme for Information Technology) to

make it easier for staff moving around the area. Common capabilities will also help with the detail and quality of information available to cross-trust organisations such as the Strategic Health Authority, the regional ambulance service, primary and social care etc. How this is achieved will probably be left to Trusts and depend on their information-technology base and know-how, ranging from continuing development of their patient administration system, or development of this with help from other Trusts, to (possibly) buying in commercial bed-management information system software.

Overcoming barriers to effective information systems support for patient flow

Trusts already using commercial or self-developed bed-management information systems provide some insights into the problems that will be faced when attempting to use the National Programme for Information Technology systems for improving the management of flows. In a few cases, they also provide some suggestions for how these might be overcome.

The development of the integrated information systems to be used across areas envisaged by the National Programme for Information Technology should overcome the current technical problems posed by the range (and different generations) of patient administration systems in use. However, a much more serious challenge to successful operational information systems is persuading clinical staff to use them. Other information systems designed for use by ward nursing staff have faced insurmountable resistance when these were perceived to increase workload and contradict with traditional culture without improve the quality of care (Wilson, 2002).

The reluctance to declare discharges, arising from workload and ward culture, was highlighted early in this paper. The response to this is frequent ward-walking by bed managers. Any occupancy system based on electronic self-reporting by wards (especially those aiming for "real-time" information) would require very high levels of compliance with bed-state/patient-location updating. A couple of Trusts using bed management information systems claim to have changed this culture through rotating ward staff through training programmes, relieving them of "constant bother" from bed managers, or helping them take pride in their ward's efficiency. One Trust has claimed to have got to the stage where there is peer-pressure to use the information system and ward whiteboards have been removed since staff prefer to use the computer terminals, being able to record information they might not want publicly displayed (Bourke, 2003). However, such sustained culture change and use associated with this sort of information system has not yet been examined and documented in external studies.

Many hospital staff regard this resistance from ward staff as a huge hurdle, and these isolated examples of culture change have so far only been reported through health-service conferences. Compliance audits (with name-and-shame and name-and-praise), as has been used to encourage discharge initiatives, and more robust application of Trust disciplinary policies might also contribute. Another approach has been to make the information systems integral to clinical procedures, for example ordering tests or discharge letters, as in Oldham (Kirby and Astle, 2002), or ensuring one stage of the process cannot register accepting a patient until he/she has been registered as leaving the previous stage. The integrated care-records service

running through the National Programme for Information Technology systems should have a similar effect.

It is important to acknowledge that in a hospital environment, information systems are unlikely to replace bed managers ward-walking entirely, as these perform other useful roles when performed by senior nurses, such as gathering qualitative information (e.g. ward staffing and associated placement risk), maintaining relationships, and policing other aspects of ward practice. A consensus amongst bed managers on the Development Programme was that one walk per shift would be sufficient if timely and reliable information was forthcoming from the wards. Even in places where there is currently a high level of compliance by wards with bed-status data-entry, some checks and remedial updates are required, for example at Oldham the bed bureau ring round the wards at midnight to check bed occupancy and make any necessary updates to the patient administration system.

Another cultural issue is the "silo" approach to "ownership" of beds and scheduling of departmental resources. There is often little sense of these being corporate resources, and that key constraints (e.g. beds) must be carefully managed to protect overall flows. Changing this is sometimes regarded as surrendering traditional powers and autonomy. However, reported payoffs to clinicians include bed-occupancy systems making it much easier for teams to find "their" patients (where such systems are more up-to-date than the patient administration system), particularly if the patients are outliers, and resource-booking leading to greater reliability in actually being able to treat the electives placed on to-come-in lists. This last was one of the motivating factors behind Royal Shrewsbury Hospitals' "Clinical Application for Logistics Management (CALM)" system (Royal Shrewsbury Hospitals NHS Trust, 1999), where development was led by a clinical consultant. However, as with occupancy systems, widespread compliance is required: if resources can be accessed or booked other than through the centralised system, scheduling and coordination cannot be done reliably. Such discipline requires considerable political will and leadership.

Obvious benefits would be better use of bed managers' time and less pressure to reassign experienced clinical staff to progress chasing.

Discussion

Acute hospitals are going through a period of considerable change, largely driven by the progressively tightening National Health Service Plan performance targets. Further major change in operating practices will be necessary to reaches the final stages, and to implement planned national initiatives including Booked Admissions, Patient Choice and Financial Flows. The importance of operational information systems has been recognized, and the major national information systems programme (the National Programme for Information Technology) specification includes many features that will support operational management, and "extend the chain" through the whole healthcare system. The ambition and scale of this programme will allow a much greater emphasis on integrated patient flows than current bed-management information systems, through the new information technology infrastructure and electronic whole-system integrated care pathways.

However, the timetable for required hospital service improvements is shorter than for the new generation of information systems, and many Trusts are considering what can be done in the interim. Whilst fundamental to service improvement in only a few

Trusts, notably those where the cultural attitude to compliance has changed, there are some very promising bed-management information systems in use.

None of the existing bed-management information systems described includes all the key features drawn out in this paper. The National Programme for Information Technology specification includes all of them. However, some of the existing bed-management information systems have capabilities more advanced than those called for in the specification, such as the project scheduling and monitoring techniques in the Goldratt Group's *Jonah* information systems for supporting in-patient discharge (Proudlove, 2004a) and the tools in *CALM* for supporting patient shuffling if schedules have to be revised in response to unusual levels of emergency pressure or very urgent elective demand. It would be a shame if this type of expertise were lost in the process of standardisation. No information system can be successful without the commitment of the users. This is a particular problem for "management" information systems requiring use by clinical staff. Experience from Trusts with a record of sustained bed management information system compliance should also be exploited.

This paper has sought to highlight the potential for bed management information systems to contribute to improving bed and in-patient flow management, and the progress made so far in developing and implementing such systems. Ultimately all parts of the system will benefit from better information and coordination of resources, resulting in smoother flows and shorter length of stay; not least the patients.

References

Audit Commission (1992), *Lying in Wait: The Use of Medical Beds in Acute Hospitals*, Audit Commission, London.

Audit Commission (2003), *Acute Hospital Portfolio: Bed Management – Review of National Findings*, Audit Commission, London, available at: www.audit-commission.gov.uk

Black, S. and Proudlove, N.C. (2003), "Improving bed management in the NHS", *British Medical Journal*, published in rapid response to Ham, C., York, N., Sutch, S. and Shaw, R. (2003), "Hospital bed utilisation in the NHS, Kaiser Permanente, and the US Medicare programme: analysis of routine data", *British Medical Journal*, Vol. 327, pp. 1257-60, 8 December, available at: www.bmj.com

Boaden, R., Proudlove, N.C. and Wilson, M. (1999), "An exploratory study of bed management", *Journal of Management in Medicine*, Vol. 13 No. 4, pp. 234-50.

Bourke, P. (2003), "BedStat: real-time bed management", paper presented at the Re-thinking Bed Management: Opportunities and Challenges, HMC conference, Barbican Centre, London, 27 February.

Commission for Health Improvement (2002), *Report of a Clinical Governance Review at Royal Shrewsbury Hospitals NHS Trust*, The Stationery Office, London, March.

Cummings, J. and Cooke, M. (2003), "*Bed management workshop*", paper presented at Emergency Care Leads' Conference, London, 2 December, available at: www.doh.gov.uk/conferences

Department of Health (2000), *The NHS Plan: A Plan for Investment, a Plan for Reform*, Stationery Office, London.

Department of Health (2002), *Reforming NHS Financial Flows: Introducing Payment by Results*, Department of Health, London.

Department of Health (2003a), *The Community Care (Delayed Discharges etc.) Act 2003: Guidance for Implementation*, Department of Health, London, 24 September, available at: www.doh.gov.uk/publications/coinh.html

Department of Health (2003b), *Implementing the New System of Financial Flows – Payment by Results*, Department of Health, London.

Department of Health (2003c), *Integrated Care Records Service: Part II – LSP Services, Output Based Specification; Second Iteration*, Department of Health, London.

Department of Health (2003d), *Learning Materials for Effective Hospital Discharge*, Department of Health, London, available at: www.dischargetraining.doh.gov.uk

Feachem, R.G., Sekhri, N.K. and White, K.L. (2002), "Getting more for their dollar: a comparison of the NHS with California's Kaiser Permanente", *British Medical Journal*, Vol. 324, pp. 135-43.

Forni, J. (2002), "A forecasting tool for bed availability – will there be enough beds for this week's elective surgery?", in *Information for Action: An NHS Good Practice Guide on Anticipatory Management in Healthcare*, Hospital Operational Intelligence Project, Department of Health, London, pp. 18-19.

Granger, R. (2003), "An introduction to England's integrated care records service", *British Journal of Healthcare Computing and Information Management*, Vol. 20 No. 10, pp. 22-4.

Ham, C., York, N., Sutch, S. and Shaw, R. (2003), "Hospital bed utilisation in the NHS, Kaiser Permanente, and the US Medicare programme: analysis of routine data", *British Medical Journal*, Vol. 327, pp. 1257-60, available at: www.bmj.com

Institute for Healthcare Improvement (2003), *Optimizing Patient Flow: Moving Patients Smoothly Through Acute Care Settings*, Institute for Health Improvement, Boston, MA, available at: www.ihi.org/newsandpublications/whitepapers/flow.asp

Jorgensen, J., Boaden, R. and Proudlove, N.C. (2003), *Greater Manchester Bed Managers' Development Programme Handbook*, Greater Manchester Strategic Health Authority, National Bed Management web site, available at: www.bedmanagement.nhs.uk/ (NHSnet only).

Kirby, R. and Astle, J. (2002), *The Oldham Bed Occupancy System*, Department of Health, London, in *Information for Action: An NHS Good Practice Guide on Anticipatory Management in Healthcare, Hospital Operational Intelligence Project*, pp. 20-1.

Mango, P.D. and Shapiro, L.A. (2001), "Hospitals get serious about operations", *McKinsey Quarterly*, Vol. 2001 No. 2, pp. 74-85.

(The) Met Office (2001), *Forecasting the Nation's Health*, The Met Office, Bracknell, The Health Forecasting Unit, June, available at: www.metoffice.com

Modernisation Agency (2003), *Bed Management Improvement Programme*, London, available at: www.modern.nhs.uk/esc

Modernisation Agency (2004), *Improvement Partnership for Hospitals*, London, available at: www.modern.nhs.uk/iph

National Audit Office (2000), *Inpatient Admissions and Bed Management in NHS Acute Hospitals*, National Audit Office, London, available at: www.nao.gov.uk/guidance/chiefexec1d.htm

NHS Confederation (2003), *Briefing 88: The National Strategy for IT in the NHS*, NHS Confederation, London, August.

NHS Modernisation Agency (2003), *Bed Management Improvement Programme. Intermediate Stage: Improving the Inpatient Journey*, London, September, available at: www.modern.nhs.uk/esc

Proudlove, N.C. (2004a), "Discharge planning and bed management – the Goldratt approach", paper presented at Developments in Bed Management, Harrogate Management Centre Conference, Hotel Russell, London, March.

Proudlove, N.C. (2004b), "Modernising bed management", in Cooke, M. (Ed.), *National Electronic Library for Health: Management Briefings, Emergency Care Toolkit*, available at: www.nelh.nhs.uk/emergency

Proudlove, N.C. and Black, S. (2004), "Improving bed management", *Health Service Journal*, Vol. 114 No. 5894, pp. 34-5.

Proudlove, N.C. and Gordon, K. (2002), "Short-term bed pressure anticipation and monitoring toolkit for bed management", Department of Health, London, in *Information for Action: An NHS Good Practice Guide on Anticipatory Management in Healthcare, Hospital Operational Intelligence Project*, pp. 24-5.

Proudlove, N.C., Gordon, K. and Boaden, R. (2003), "Can good bed management solve the overcrowding in A&E?", *Emergency Medicine Journal*, Vol. 20 No. 2, pp. 149-55, available at: http://emj.bmjjournals.com/cgi/content/full/20/2/149 (subscription required).

Royal Shrewsbury Hospitals NHS Trust (1999), *Beacon Status – CALM Project*, available at: www.rsh.org.uk/beacon

Walley, P. and Davies, C. (1999), "Operations improvements in UK hospital trusts", Proceedings of *5th International Conference of the Decision Sciences Institute: Integrating Technology and Human Decisions, Athens, Greece, July 1999*, Vol. 1, pp. 671-673.

Wanless, D. (2002), *Securing our Long-Term Health: Taking a Long-Term View*, HM Treasury, London, April, available at: www.hm-treasury.gov.uk/Consultations_and_Legislation/wanless/consult_wanless_final.cfm

Wilson, M. (2002), "Making nursing visible? Gender, technology and the care plan script", *Information Technology & People*, Vol. 15 No. 2, pp. 139-58.