

SAFETY AND COMPLEXITY: INTER-DEPARTMENTAL RELATIONSHIPS AS A THREAT TO PATIENT SAFETY IN THE OPERATING DEPARTMENT

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Purpose: Current thinking about ‘patient safety’ emphasises the causal relationship between the work environment and the delivery of clinical care. This research draws on the theory of Normal Accidents to extend this analysis and better understand the ‘organisational factors’ that threaten safety.

Methods: Ethnographic research methods were used, with observations of the operating department setting for 18 month and interviews with 80 members of hospital staff. The setting for the study was the Operating Department of a large teaching hospital in the North-West of England.

Results: The work of the operating department is determined by inter-dependant, ‘tightly coupled’ organisational relationships between hospital departments based upon the timely exchange of information, services and resources required for the delivery of care. Failures within these processes, manifest as ‘breakdowns’ within inter-departmental relationships lead to situations of constraint, rapid change and uncertainty in the work of the operating department that require staff to break with established routines and work with increased time and emotional pressures. This means that staff focus on working quickly, as opposed to working safely.

Conclusion: Analysis of safety needs to move beyond a focus on the immediate work environment and individual practice, to consider the more complex and deeply structured organisational systems of hospital activity. For departmental managers the scope for service planning to control for safety may be limited as the structured ‘real world’ situation of service delivery is shaped by inter-department and organisational factors that are perhaps beyond the scope of departmental management.

Keywords

Patient safety, operating department, organisational complexity, normal accidents

Research paper

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Introduction

Over the last decade there has been a growing international recognition that health care services are dangerous places and constitute significant threats to the safety of patients (World Health Organisation (WHO), 2004). For the National Health Service (NHS) of England and Wales it is estimated that one in ten hospital patients experience some form of clinical error. On an annual basis it is calculated that there are as many as 850000 such incidents, costing the NHS over £2billion in extra and remedial care and potentially claiming the lives of up to 40000 patients. Such figures are not unique to the UK but have been found in other Western health care systems (WHO, 2004).

‘Patient safety’ is now a major UK health policy priority, with ‘safety’ designated as a leading ‘standard’ for the Healthcare Commission’s assessment of health care providers. A National Patient Safety Agency (NPSA) has been created to lead policy development and champion service-wide learning across the NHS, with a National Reporting and Learning System (NRLS) being established throughout the service. The NRLS is seen as offering a robust and proactive system of organisational learning and safety management that routinely gathers information about the actual and potential risks to patient safety, thereby enabling the identification of opportunities for service improvement (NPSA 2003). A significant element of the patient safety agenda has been to promote a new way of thinking about safety, whereby risks are not seen as merely the result of chance or ‘human error’, but rather the product of underlying factors located in the wider socio-organisational context of care delivery. In policy, this ‘systems approach’ (Reason, 2000) is articulated as ‘root cause analysis’, encouraging service leaders to seek out the underlying threats to patient safety preconditioned within the organisational and inter-personal environment of clinical work (NPSA, 2003). An important issues for health service management and quality improvement is the degree to which this ‘root cause

analysis' should be undertaken, i.e. at what level is causality seen as residing. Much of the prevailing theoretical and empirical work in this field typically focuses on the relationship between individual performance and the immediate work context. This paper is concerned with exploring and extending the application of these ideas to better understand the organisational context.

The focus of our study is the hospital operating department, which is often categorised as an unsafe area of care provision. For example, an analysis of 1200 completed hospital cases by Health Care Risk Resources International found that operating theatres were 'high risk' and that within the processes of surgical care the greatest risk to safety was 'unintentional damage' to the patient (28%), followed by 'diagnostic error' (27%) (Wilson, 1999). A prospective examination of outcomes for over 4,500 surgical patients in a US University teaching hospital suggested that between thirty and fifty per cent of major complications in patients undergoing general surgical procedures are avoidable (Healey et al, 2002). One recent study suggested that the probable incidence of error in the surgical intensive care unit is potentially as great as one in every two patients (Krizek, 2000), and another retrospective case review detected that up to 16.2% of General Surgery records contained instances of 'adverse events' (Vincent et al, 2001). There are many threats to safety in the operating theatre, associated with the invasive nature of surgery, professional competence, the inherent risks of anaesthesia, and the quality of teamwork with the theatre (Carthey et al, 2003). Reflecting a 'systems approach' one recent study of urgent and emergency surgery found that the safety of more than half (54%) of all cases was threatened by organisational factors related to competing demands, unavailable information, and the late arrival of staff or patients (Pearse et al, 2001). In this paper we draw on ethnographic research to further investigate these organisational factors in the operating theatre with the aim of locating them within a broader analytical and theoretical perspective from which to frame our analysis.

Theorising the threats to patient safety

As indicated above, much of the current thinking about 'patient safety' has been informed by the theories of cognitive and social psychology, ergonomics, and the Human Factors approach or what is sometimes called 'safety science' (see Department of Health, 2000). Whereas cognitive psychology shows how the schema of mental performance can fracture or lapse leading to human error (Rasmussen and Jensen, 1974), social psychology highlights the interplay between this cognitive dimension and the environmental context of behaviour. A conceptual distinction is made between the *active errors* of individual behaviour at the 'sharp-end' of work, and the *latent factors* located 'upstream' within the work system that influence individual or group performance (Reason, 1997). These 'factors' can include, the design of tasks, the nature of teamwork, the management of equipment, and the presence and effectiveness of instructions, safety checks or backup systems (Reason, 1997). When considering the threats to safety, attention is therefore directed at those factors that enabled or exacerbated the potential for human error (Leape, 1999). Applied alongside models of quality assurance and risk management this approach, together with the principles of High Reliability Theory (Rochlin, 1987), represents a prevailing discourse for organisational learning and safety.

Within the health care context the Human Factors approach has consistently been promoted as a new and alternate way of addressing the problems of clinical error and patient safety (Department of Health, 2000; Leape, 1999; Vincent, 1993; Reason, 2000). Vincent and Reason (1999) have applied this approach to show that the threats to patient safety are rooted in 'task', 'team', 'situational' and 'organisational' factors. 'Task factors' include, for example, a lack of work standardisation or excessive reliance on memory; 'team factors' include issues of communication, leadership, decision-making and situational awareness; 'situational factors' are those found in the immediate work environment such as time pressures, information flows, poor procedures, and the design of human-system interfaces; whilst 'organisational factors' include the presence of early warning or defensive systems, the contribution made by incident reporting and the extent of organisational redundancy. Vincent et al (1998) have added to this categorisation to

suggest that the threats to patient safety are brought about by even wider socio-organisational factors, including the ‘institutional context’ of health care politics and policy, together with a broader understanding of ‘organisational and managerial factors’ that considers in the wider role of management planning and organisational cultures. In policy, these ideas are articulated as ‘root cause analysis’, the philosophy by which the service should seek out the threats to patient safety to make service improvement, principally through participating in the new systems of incident reporting and risk management found in the NRLS and then identifying the underlying latent factors that threaten safety.

Although the prevailing ‘systems approach’ certainly moves beyond an individualised ‘person-centre’ understanding of human error (Reason, 2000), its predominant focus remains at the micro level of individual or group performance. Mezzo and macro level issues, for example, organisational networks, occupational cultures and political pressures are recognised as influencing safety (e.g. Vincent et al, 1998), but they are not developed theoretically or empirically as distinct and inter-related levels of analysis. In other words there is a reductionist tendency to conflate analysis to the level of the individual and the immediate work environment (the psycho-social), rather than consider the distinct and inter-connected contributions at the mezzo (organisational-cultural) and macro (social and political) levels. In the practical terms of ‘root cause analysis’ this may mean that organisational learning fails to adequately explore the broader (or fundamental) socio-cultural or organisational causal factors being more concerned with the more apparent factors located within the work environment. In addressing these other dimensions insight can be gained from other writers (Turner, 1978; Perrow, 1984; Vaughan, 1996) who have more thoroughly explored the social and cultural nature of organisational deviance, accidents and safety.

When considering the organisational dimension, especially the structures and processes of work, much can be gleaned from Perrow’s (1984) study of ‘normal accidents’. He suggests that for organisational systems dealing with complex technologies (or tasks) accidents are inevitable or *normal*, not purely because of the high-risk nature of work or

the potential for ‘operator error’, but because of the way work systems are organised in to encourage isolated ‘discrete failures’ to cascade out of control and escalate into more substantial disasters. This is elaborated along two lines: ‘interactive complexity’ and ‘organisational coupling’. ‘Interactive complexity’ refers to the process by which commonplace, small and ‘discrete failures’ often located within different organisational sub-systems can interact and combine in unexpected and sometimes undetectable ways, and within sufficiently complex systems these can produce more profound accidents. Linked to this is an understanding of how organisational sub-systems are arranged and the degree of inter-dependence or ‘coupling’ between organisational processes. Where organisational units and activities are ‘tightly coupled’ failures located within one process can spread throughout the wider system through a series of escalating knock-on effects as interdependent tasks and processes are progressively compromised or impaired, especially for time-dependant processes that rely on specialised staff and resources that cannot easily be substituted. An organisation’s structural arrangements can therefore transform risky or dangerous situations into disasters or normal accidents (Perrow, 1984).

Despite directing our attention to ‘the system’, the prevailing theories of ‘patient safety’ do not fully engage with the existing organisational and sociological theories that can better inform our understanding of the complex organisational factors that shape the delivery of patient care and can turn insignificant failures, often overlooked by clinical staff, into more significant, but also normal, accidents in care delivery. Although Normal Accident Theory tends to focus on the development of major disasters and it is sometimes seen as excessively pessimistic, particularly in contrast to the proactive and managerial stance of ‘safety science’ and High Reliability Theory (Rijpma, 1997), it nevertheless provides a basis from which to better understand the organisational context of safety in health care. In this paper we draw on the work of Perrow (1984) to more advance a less reductionist approach to safety that seeks to more thoroughly understand the threats to patient safety manifest within the organisational structures and processes of the operating department, whilst also considering the relationship between this organisational level and the micro levels of patient care.

Methods

This paper is based upon an ethnographic study carried out between 2003-04 in the operating department of a single large teaching hospital in northern England. We used standard ethnographic research methods to investigate social, cultural and organisational issues related to patient safety within this setting, including observations, informal and formal interviewing and documentary analysis (Hammersley and Atkinson, 1995; Finn and Waring, 2005). Ethical approval was obtained in advance of the study through the Local Research Ethics Committee and participants were informed of the study's objectives.

We carried out non-participatory observations within the operating department on a daily basis for 18 months. These observations took place in various locations, such as staff rooms, management meetings, corridors, reception areas and various clinical settings, including ten operating theatres with adjoining anaesthetic rooms and two recovery areas. From these findings we also made observations of other hospital settings related to the work of the operating department, including outpatient clinics, surgical wards and laboratory services. From these observations we were able to 'map' the organisational networks, processes and relationships that contributed to the work of the operating department, including a record of recurrent 'bottlenecks', 'crisis points' and 'breakdowns' in the planned or designated working arrangements as perceived by staff members. A further period of observations was undertaken to better understand how these organisational issues affected the routines and patterns of work within the operating theatre. Our observations were recorded in field journals together with reflective notebooks.

Alongside our observations we interviewed those involved in the work of the operating department both formally and informally. Informal interviews were carried out in situ whilst making our observations and involved opportunistic chats and conversations with

staff members. These were used to clarify and further understand work activities and were recorded alongside our observational records. We also interviewed 80 members of hospital staff more formally outside the immediate work setting, including 14 consultant-grade surgeons of mixed speciality, 12 consultant-grade anaesthetists, 14 members of theatre nursing staff of mixed grade, 4 operating department managers, and a range of managers, administrators and professional representatives from other hospital departments, as well as senior hospital managers and executives. These participants were purposively selected on the basis of their occupational role and contribution to the working of the operating department. These semi-structured face-to-face interviews were recorded electronically with the consent of the participants and followed a topic guide that involved asking participants to describe their work environment and activities, with particular focus on what they saw as the as the threats to patient safety within their work context. This guide evolved throughout the research process to reflect emerging issues and topics that were of theoretical relevance.

The interview data, together with the observational records, were electronically transcribed and entered into the computer package *Atlas ti* for the purpose of data analysis, which followed the strategic principles of grounded theory (Glaser and Strauss, 1967). This was led by two of the authors who scrutinised the findings to develop a descriptive understanding of the operating department's structures, systems, process and group and individual activities. Through this process we were able to develop conceptual models of the operating department with reference to its interactive complexity and couplings in the form of inter-departmental relations. We further analysed the data to identify and code the descriptions, attitudes, assumptions and viewpoints of individuals and professional groups involved in the work of the operating department to understand how organisational processes could impact upon the safety of practice. These coded findings were further compared and contrasted for their consistency and conceptual relationships, and with the observational records provided the basis of our analysis.

The findings

The operating department as a tightly coupled 'organisational hub'

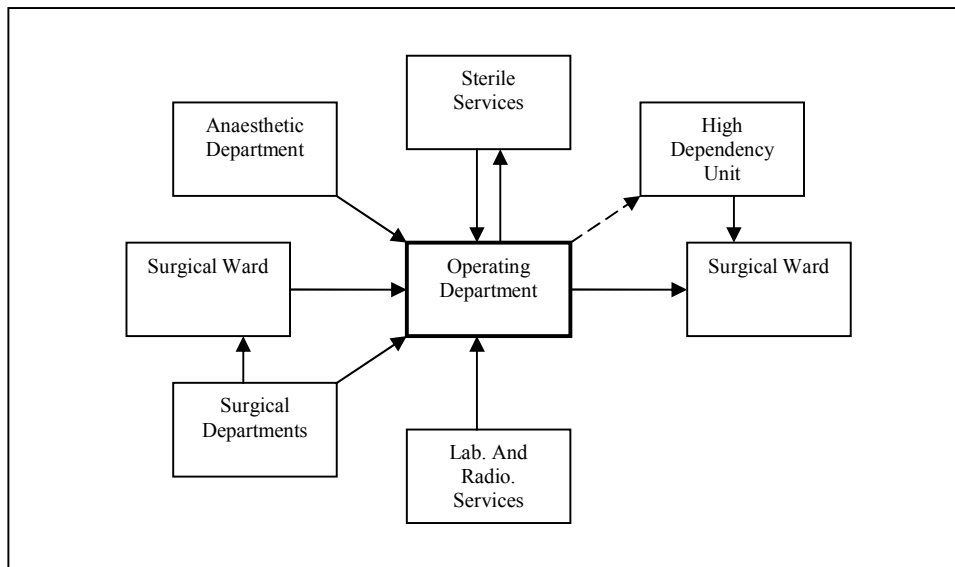
The operating department is, in broad terms, concerned with the planning, preparation and provision of the operating theatre environment for the delivery of surgical care. 'Theatres' constitute a specialised space that, unlike most wards and clinics, is closed off from other areas of the hospital, has controlled environmental conditions for light, air and aseptic conditions, relies upon a supply of specialised drugs, equipment and instrumentation, and is the designated setting for the delivery of surgical care carried out and supported by a group of specialist professionals. In order for operating department to prepare and maintain this environment for the safe delivery of surgical care it relies upon the communication, exchange and transfer of essential resources, services, information and skills from other hospital departments. A number of prominent hospital departments were identified as providing essential 'ingredients' in the work of the operating department. Each of these possess a series of specialised tasks that together, through a series of inter-departmental interactions, contribute to the overall care of the patient, either directly through providing clinical care or indirectly through providing support services to the operating department (see figure 1). For example, it is on the surgical wards care that the patient receives care both before and after surgery and the wards have an important relationship with 'theatres' primarily for preparing and transferring the patient; departments such as the Sterile Services Unit (SSU), Histopathology and Radiology provide important patient information and specialist equipment and resources needed for surgical care; and the High Dependency Unit (HDU) has important post-operative links with 'theatres' for the provision of intensive care. For surgical care within the operating department to be both effective and safe these other departments must function satisfactorily and also interact appropriately with 'theatres'. It is also worth considering that in terms of staff allocation surgeons and anaesthetists are also based within other specialist hospital departments and therefore decisions taken about staff allocation and planning are also made outside the realm of operating theatre management, with only theatre nurses (including anaesthetic, scrub and recovery) and other support

staff, such as Health Care Assistants being based within the operating department. When these organisational arrangements and processes are conceptualised as a network of inter-dependant organisational units and processes, the operating department can be interpreted as the ‘organisational hub’ to which key relationships must be active within particular temporal and spatial parameters (see Figure 2).

Figure 1. Prominent departmental functions integral to operating department performance

<i>Department</i>	<i>Function</i>
Surgical ward	Where patients receive pre- and post- operative care
Sterile Services	Where surgical instruments are sterilised, maintained and prepared
High Dependency Unit	Where high-risk patients receive intensive post-operative care
Radiology	Where diagnostic images are taken and analysed pre-, inter- or post-operatively
Histopathology	Where biological specimens are analysed pre-, inter- or post-operatively

Figure 2 The Organisational context of the Operating Department



“[T]here’s a lot of pressure outside. You see we think of theatres but of course you have to think of all the pressure outside, like the wards, HDU beds...” (P5)

“Everybody is juggling, it is just getting it right in the end really isn’t it and making sure things run smoothly and not rushing too much.” (P8)

Theatre management readily acknowledged the pressures and constraints placed on the operating department by these other departments and inter-departmental relationships. We found that a significant role of the management team was to ensure that these relationships were appropriately planned and co-ordinated for each scheduled surgical procedure. We observed how on a daily basis department managements and senior members of nursing staff would strive to secure and maintain stable and co-ordinated relationships with these other hospital departments, often negotiating arrangements over the telephone or in person at the last minute to safeguard the provision of supplies or track down missing items. In addition to these *ad hoc* activities at the ‘coal face’ of

departmental work, we also found that departmental management convened a weekly 'scheduling meeting' with representatives from these other departments. The explicit purpose of this meeting was to discuss and plan the resource, skill and information needs for each scheduled surgical procedure detailed on the 'theatre lists' for the following week. The aim of this meeting was to more accurately schedule and arrange departmental activities around the designated list of surgical procedures, through anticipating and planning the resource and information needs, the staff skill-mix, and the need for specialised post-operative care and in doing so enabling operating department to function effectively. Although this meeting enabled each department to plan their own work activities in relation to the needs of others, we noted that the changes made were largely confined to the individual department with little attention given the relationships between department or perhaps more significantly to the intrinsic role by the structured organisational arrangement of hospital departments and activities.

When attempting to understand how these organisational arrangements and processes may provide the opportunities and catalyst for unsafe patient care, it is worth returning to Perrow's (1984) analysis of normal accidents. According to this perspective, accidents or in this case the risks of unsafe patient care are more likely to arise where the organisational context is characterised by 'interactive complexity' and 'tightly coupled' processes. As suggested by our initial findings the work of the operating department is dependant upon the activities of various other hospital departments. Each of these possesses a distinct series of tasks, using specialised staff and resources, and through the completion of these activities they contribute to the delivery of surgical care. Within each of these hospital departments exists the inherent potential for human error or the failure to adequately complete tasks, but given the tight coupling between departments there exists the potential for minor, insignificant or overlooked to spread, combine and escalate across the wider network and ultimately threatening the safety of patient care. This is especially the case for the operating department at the centre or 'hub' of the organisational network, which is highly dependant on these other hospital departments for specialised, time-dependant and irreplaceable resources. The potential for danger in

the operating theatre is therefore perhaps inevitable or normal because of its dependence on inter-departmental relationships with other specialised hospital departments.

This theoretical analysis adds to and compliments the prevailing Human Factors approach by elaborating upon our understanding of how systemic organisational arrangements can represent potential risk factors. By modelling the organisational context of the operating department in this way our next question was to understand how and in what ways do these tightly coupled and complex inter-departmental interactions threaten organisational and patient safety.

Inter-departmental breakdowns

The operating department's dependence upon these other specialised hospital units for essential resources, skills, information and support meant that failures experienced in one department could easily be transmitted to the wider network and have further repercussions for the effective and safe delivery of surgical care. The source and nature of these 'problems' were various and in many ways unique to the specific department, for example, SSU had consistent problems with staff retention, whilst the surgical wards often struggled to function when dealing with the competing demands of new admissions. With reference to the activities of the operating department the impact of these isolated issues was manifest in what we have termed 'organisational breakdowns'. This is where one inter-departmental interaction would fail or slip out of sequence due to problems experienced within one department, modifying or fracturing the planned exchange of goods and services, and introducing secondary pressures within the work of the operating department. Our observations, supported by interview data, reveal many of these 'breakdowns', which we divided into three categories; delays (items delivered at the wrong time), miscommunications (items or information with the incorrect content) or missing transactions (where items fail to be exchanged). Each of which can be seen as framed by the complex tasks carried out by each department and also their high degrees of inter-dependency.

The operating department's relationship with the surgical wards was the most frequent site for systemic failure. For two thirds of the scheduled operations we observed delays in the scheduled transfer of the patient from the surgical ward to the operating department of between 5 and 20 minutes. These were typically the result of competing tasks, staff shortages and technical difficulties within the wards. We also found that interactions between the operating department and the surgical ward were characterised by missing information, such as the patient's signed consent form, whilst on a number of occasions patients were brought to theatre without being appropriately prepared for surgery, for example, they were still wearing jewellery or dentures, or had not been given the appropriate sedatives.

“You phone up at 8.00am and say ‘so and so, and so and so need to be ready’, [but] you can send for your first one and you can find that the porter has gone to the ward and they are not ready, their bloods are not done, there are problems with consent, big issues that delay things.” (P8)

The collection of post-operative patients for their return to the ward also incurred frequent delays, with about one quarter of these transfers between the operating department and the ward delayed in excess of 15 minutes. This had the effect of blocking beds on the department's recovery unit, where post-operative patients received specialist care whilst recovering from the anaesthetic and surgery, and created log jams in the flow of departmental work. On a number of occasions where ward staff were absent or excessively delayed, recovery nurses were required to leave designated duties in order to transfer the patients to the ward thereby leaving the unit short of staff.

“We have had to wait 40 minutes sometimes for the ward staff to collect the patients. I know they are busy and everything, but it blocks our beds and effects how we work...we have had to take some of the patients back ourselves but then you have the problem of being a staff member down” (Recovery nurse: field notes)

For patients needing intensive post-operative care, theatre staff, typically the theatre sisters, were required by departmental policy to request and secure a specialist bed within the HDU, *before* commencing surgery. Although these were often reserved several hours or days in advance of the operation, based upon the scheduled list of procedures, we found that around half of those operations needing this type of post-operative care were delayed in their start by between 10 and 40 minutes because a HDU bed could not be guaranteed. The time in which these delays were most common was early in the morning, especially Mondays as the HDU dealt with weekend emergencies. On two occasions we also recorded how an pre-arranged and guaranteed HDU bed became occupied by another patient mid-way through the surgical procedure, which resulted in the designated surgical patient being deprived of this specialist bed for over 30 minutes, during which time the post-operative patient remained anaesthetised in the operating theatre until a bed was made available, but this introduced further risks to patient care and the planned work of the operating department. Where delays were expected to be long surgical staff would suggest re-arranging the order of patients or cancelling the operation, which further introduced further complications in the work of the operating department.

“We had one case where somebody was cancelled because there was no HDU bed, so just one of the resources was not there, and the patient went home with a new date organised and died in between.” (P42)

The relationship with SSU could also affect the workings of the operating department. The provision of surgical instrumentation was based upon the designated schedule of surgical procedures, whereby the appropriate instrumentation ‘tray’ would be sterilised and made ready for use before being transported to theatre. It was expected that

instrumentation would be delivered in advance of the surgical start time to enable nursing staff to complete all necessary checks and preparations. However, for a significant number of operations the delivery of this equipment was often delayed due to staff shortages, equipment failure or time pressures within SSU. We recorded that these delays rarely occurred early in the mornings as SSU was able to clean and prepare equipment 'out of hours', but it struggled to turn-around instruments within a short time period between similar procedures. Furthermore, on a small number of occasions instrumentation was brought to the operating department which was either incorrect or faulty, indicating shortcomings in the capacity for this department to clean and check surgical equipment thoroughly, which was often seen as the result of staff shortages. Again these problems placed further time and resource pressures on work in the operating department.

“We have just sent two Health Care Assistants to SSU to collect the trays, they are short of staff and can't cope...we often help out...we need to if we want to get on with the list” (Theatre Sister: field notes)

“[its important]...all the instruments are sterile, I mean yes, we do get instances where we don't have the right tackle available, or we have malfunctioning equipment.” (P53).

We observed that the relationships with Histopathology and Radiographic services also had the potential to undermine the workings of the operating theatre, although to a lesser extent than some of the other departments. We found that delayed, missing or incorrect exchanges of information, such as blood supplies, test results and X-rays could seriously undermine and impair anaesthetic and surgical decision-making during or immediately prior to the start of an operation. From our observations of anaesthetic work we recorded that about a quarter of anaesthetists experienced some form of delay for pathology results, and on a small number of occasions the late delivery of X-rays or other scans impeded surgical activity. More significantly on two occasions we recorded how the wrong test results were delivered to the operating department. In most cases it appeared

that the tests and X-Rays in question were generated by last minute requests for information.

“Another issue is with pre-operative blood test which may not be available. One of the lists I do is a renal list and the patient should have the potassium levels measures...but sometimes the potassium is not available.” (P20)

“We have had to delay surgery for several hours because there is no blood available” (P29)

“The great urological example is the surgeon who took the wrong kidney out, you have X-rays not available, X-rays wrongly marked, people making assumptions.” (P54)

Given the operating department’s function dependence on these inter-departmental relationships such ‘breakdowns’, either as delayed, missing or incorrect exchanges constituted significant problems to the effective and safe delivery of surgical care, as the network of organisational interactions would fracture and de-align from what was scheduled. Returning to our earlier analysis it was apparent that each of these specialist departments experienced certain failures of problems in completing their tasks, often associated with the endemic problems of resource constraint and competing demands, but because of the tight coupling between departments, these rarely remained isolated within each department but instead combine and spread across the wider organisation manifest as organisational breakdowns, and influencing the work of the operating department at the hub of this network.

“Well the organisation is chaotic, and in a chaotic organisation risk is always there...there is no order.... At the moment it is like Concorde is about to take off in three minutes, so you are on the flight deck and you suddenly think have we put all the petrol in, the pilot isn’t here, where’s the food!” (P19)

The impact on the operating department and patient safety

Many of these organisational breakdowns were small in character and isolated to a single inter-departmental exchange, having little impact upon the overall workings of the operating theatre at the centre of this hospital network. Typically they introduced slight adjustments to the start and finish times of the surgical procedures as delayed, missing or incorrect exchanges were rectified. Our observations indicated that staff working in the 'theatres' had learnt to cope with many of these problems, whilst in some cases one problem could coincidentally offset or compensate for another. For example, the delayed arrival of a patient from the surgical ward could give the theatre staff additional time to complete instrumentation checks, or the wait for a guaranteed HDU bed often gave the anaesthetists extra time to acquire missing test results. On many occasions staff also used these situations to take missed breaks or talk with colleagues. We found therefore that in both organisational and cultural terms the operating department had come to expect, tolerate and work with many of these problems. We also noted, however, that because staff had come to expect and accept many of these situations this had the perverse effect of further undermining the smooth running of theatres as some staff members, especially surgeons, would often arrive late to the operating department assuming that the scheduled start time would already be postponed.

Nevertheless, these breakdowns did have a negative impact on the provision of surgical care, especially when key resources failed to arrive or were delayed in excess of 20 minutes. Furthermore, these breakdowns could have a cumulative effect as one inter-departmental relationship fractured, for example between theatres and the ward, this could further de-align relationships with other departments, such as between theatres and HDU, leading to increased change and uncertainty across the wider system. This seemed to indicate that despite weekly management planning, the organisation of this network was inflexible to the changes and problems that often emerged within any one relationship. We found that during these periods the operating department was characterised by high degrees of constraint (time, resource or emotional pressure), change

(as plans were modified to accommodate constraint) and uncertainty (as staff struggled to understand what these changes involved). These situations could have a profound effect on the delivery of surgical care through negatively influencing individual and group work within and around the operating theatre.

Perhaps the most obvious consequence of these breakdowns was the introduction of constraint and pressure in the work of the operating theatre. This was typically found in two ways, time pressures brought about by delays or changes to the scheduled theatre timetable, and resource constraints as staff were forced to work in sub-optimal conditions. Time pressures were brought about by delayed inter-departmental exchanges or during the periods when missing or incorrect exchanges were rectified. At first these situations would enable staff to complete other tasks more thoroughly, for example, nurses would have greater preparation time and surgeons could attend to 'paperwork'. However, these situations would invariably postpone the scheduled time of a procedure and when the missing, delayed or incorrect resources were remedied there was greater pressure on staff to work more quickly with the intention of making up 'lost time'. This could be seen with all staff groups increasing the pace at which they worked. For example, anaesthetic staff would often comment informally on the pressures to prepare and anaesthetise the patient quickly, whilst for the surgeon, it was recorded how time constraints placed pressure on them to 'close' and finish the procedure more rapidly thereby saving or making time.

"I think it is putting more stress on the individual practitioner because they don't have enough time to make a careful enough assessment of patients before they start because of this pressure" (P15)

"There are time factors because you have got a set period of time to do the anaesthesia and you have got a list with a set number of patients on and you have got to make sure those two things fit together" (P21)

These situations were seemingly made worse when incorrect or delayed resources could not be rectified. In some observations the nature of the missing resource meant that the operation was cancelled, for example with unavailable HDU beds or malfunctioning instrumentation. In other, less severe, cases these shortcomings seemed to make it more difficult for theatre staff to complete their work, for example we observed several instances of surgeons improvising with equipment, ‘making do’ with what was available, rather than cancel or change the theatre schedule.

Where certain resources were unavailable or delayed by over 30 minutes the pressure to work faster or improvise was replaced by the need to change the planned schedule of work. This would either involve switching the order of patients within one operating session or postponing the operation until another day. One of the most common sources of change was due to the lack of HDU beds, whereby the planned procedure would be re-arranged for later in the day or week when a bed would be available. However, other inter-departmental problems could also necessitate change, for example a patient inadvertently being given food on the surgical ward thereby preventing anaesthesia. These changes were often made on the assumption that it was not just technically necessary but also *safer* to change the planned procedure. However, these changes, often made at the last minute, introduced a range of additional pressures and difficulties into the ways in which the wider system functioned and ‘theatre’ staff worked. In particular changes to the scheduled order of operations could de-align other planned inter-departmental exchanges arranged for other operations within the same day, for example, in one of our observations the first patient of the day was cancelled due to the lack of HDU beds with the second planned patient being brought forward in the surgical list, but the resources needed for this procedure, such as test results and equipment, were not in place because they had been planned for a later time. These situations therefore created their own problems as the wider inter-departmental network of supplies and resources were not geared up to these last minute changes, further exacerbating the delays, time constraints and the uncertainty of work. Specifically, staff seemed to be unsure about what they were supposed to be doing, and struggled to make sense of and bring order to a rapidly changing work environment.

“Risk comes along when things are changed at fairly short notice and I think one of our big risks is actually the operating list itself, [when] the list has changed, the patients have changed order or you have sent for a patient off one list and then the porter will come back with the wrong patient” (P8)

“Another safety issue is changes to the operating theatre list order...this is a huge safety issue in that if the second patient on the list is Mr Joe Bloggs who is having a left side hernia repaired and you swap him for Mr John Smith who is having a right side hernia repaired there is a significant chance of somebody giving the wrong person the wrong operation” (P20)

Ultimately these constraints and changes introduced high levels of uncertainty into the work of the operating department. We observed how staff members would become increasingly anxious, confused, or hot-tempered when trying to cope with and deal with these unfolding circumstances. There was a general sense that the surgical team was starting to unravel as they were placed under increased pressures, struggled to cope with the unplanned changes occurring around them and had to face growing uncertainties in their work. Communication would become fractious and incomplete, for example, staff would sometimes fail to ‘read-back’ number counts when carrying out instrumentation or swab checks; decision-making would become dominated by the surgeon with little regard to the needs or work of other staff members within the theatre; individuals would often revert back to working within their specialist professional groups rather than engaging in multi-professional teamwork; and hostility in the theatre was common, for example, surgeons would sometimes shout at the theatre nurses for not completing their preparations within time, and on a number of other occasions both surgeons and theatre nurses would complain about the slow work of the anaesthetists further holding up the theatre order. It was also noted how during these situations staff would sometimes deviate from planned activities and departmental policies, for example, in order to expedite procedures certain equipment checking procedures would be missed or short-cut as staff sought to make back time. Although relatively rare notable occasions include the

preparation of pain relief, the checking of anaesthetic machine, and the pre-operative instrumentation counts. In general this uncertainty, the underlying basis of risk (Lupton, 1999) required professionals to work 'on the edge' (see also Fox, 1975) where there was little slack to accommodate potential unsafe or substandard practice.

“Well I think the knock on effect is that you may find yourself dealing with a list of patients who haven't been as well prepared as you would have liked and you are having to rely on your wits at the time to solve any problems.” (P15)

“You forget things, you can't remember which patient you are anaesthetising, you can't remember which side, you do something on the wrong side and generally your mind is just not thinking about the job, you are thinking about something else” (P19)

When inter-departmental relationships broke down the delivery of surgical care in the operating theatre was characterised by constraints, changes and uncertainties which impacted upon individual and group work. Individuals would become anxious, irritable and erratic; communication between group members would be fragmented, confrontational and incomplete; and the normal routines and checks would be sometimes be missed or cut short. It can be anticipated that under these conditions the delivery of surgical care is likely to become less than optimal and potential unsafe.

Conclusions

The work of hospital operating department can be seen as part of a complex system or network where work in operating theatres is heavily dependent upon other hospital departments (Plsek and Wilson, 2001). Despite efforts by managers and administrators to plan the work of the operating department and co-ordinate these inter-departmental relationships we found that 'breakdowns' within this network, whether delayed, missing or incorrect exchanges, impaired and comprised the effective functioning of the

department, through introducing constraints, changes and uncertainties. The prevailing logic of patient safety policy draws on attention to the 'upstream' and 'latent factors' that threaten patient safety, but as suggested earlier this form of analysis typically remains focussed at the immediate environmental factors that shape group or individual practice, or those issues that are perhaps more amenable to management-led change. Drawing from the work of Perrow (1984) we have widened our analysis to look more at the organisational system or network that shapes the delivery of care in the operating department. Here we find that the operating department is 'tightly coupled' and dependant upon the performance of other hospital departments. Each of these departments has the potential to experience rapid change or operational failure, which is not always contained to the individual department, but ripples across the wider network of inter-departmental relationships affecting the work of the operating department and also producing a cumulative feedback effect back across the wider organisation. The inflexibility of this network to respond, accommodate or tolerate these ripples undermines the effective and safe workings of the operating department at the centre of this network. As such the organisational complexity and inter-dependency of the operating department turns minor or isolated incidents into more profound uncertainties and risks, and in doing so making the threats to patient safety almost normal. This analysis builds on and extends the prevailing understanding of patient safety and latent factors found in policy.

The picture of the operating theatres environment emerging from our study was as a place where teams struggled to deliver services under difficult circumstances. Teamwork, in this context, appeared to be interpreted as a process of speeding up working processes in response to time pressures. However, what this means is that members of staff are unlikely to deviate from or voice objections to the pursuit of this common purpose, even though this increases risks to safety in the operating theatre. Whilst it may be difficult to influence these cultural norms about what constitutes appropriate behaviour (Stryer and Clancy, 2005) there are other actions, which can be taken more immediately to reduce threats to safety. In particular, our data highlight that workload planning and theatre timetabling must be informed by an appreciation of wider systems factors, as opposed to

focusing on discrete elements and simply monitoring the actual versus planned time taken to complete operations.

By characterising the work of the operating department in terms of its tight couplings with other hospital departments it is possible to suggest that greater attention should be focussed on loosening the interactive bonds to introduce slack and redundancy into the functioning of the network. The idea of improving redundancy and establishing better back-up systems certainly conforms to the principles of High Reliability Theory (Rijpma, 1997), but it is also worth bearing in mind Perrow's (1984) observation that increased redundancy is often difficult to achieve when dealing with organisations with differentiated and complex tasks and where processes have common determinants of success, i.e. the source of uncertainty can affect both the primary and back-up system. The management and planning of the operating department largely failed to take account of the wider relationships that impact on performance. Although it was recognised that each unit should perform better individually and co-ordination was needed between departments there was a tendency for managers to consider each part in isolation when planning and scheduling theatre work, for example how the wards could impact upon theatres, but not how the wider network as a whole functioned. As such the aim of managers was to more thoroughly and tightly plan the work of the department and its resource needs from other departments, but this failed to consider the inter-dependence and how small problems could have a knock-on or ripple effect for the wider network. This reflects much current management thinking, which largely assumes that a well functioning organisation is akin to a well-oiled machine and treats each part of the machine as a discrete entity (Taylor, 2003). This tendency to focus analysis and change at the departmental level is further advanced by the prevailing logic of patient safety that tends to reduce analysis to the localised work environment and not the wider organisational structures. By failing to take into account the 'real world' context of service organisation the risks to patient safety are increased.

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