

Rapid Response Report NPSA/2010/RRR009: Reducing harm from omitted and delayed medicines in hospital

February 2010

Supporting Information

Contents

1. Background.....	2
2. Review of evidence of harm.....	4
3. Medicines reported as omitted or delayed that cause serious harm.....	4
4. Qualitative data	5
5. Causes of omitted and delayed medicine incidents.....	7
6. The Productive Ward	9
7. Medicines management procedures.....	9
8. The timeliness of medicines administration	10
9. Summary.....	10
Appendices	11
References.....	14

1. Background

Medicine doses may be frequently omitted or delayed in hospital for a variety of reasons. Whilst only a small percentage of these occurrences may cause harm or have the potential to cause harm, it is important to recognise that harm can arise from the omission or delay of critical medicines. This can happen as a result of errors during the prescribing, dispensing, supply or administration of the medicines in hospitals.

A review of medication incidents by the National Patient Safety Agency (NPSA) in 2007¹ revealed that omitted and delayed medicines was the second largest cause of medication incidents reported to the Reporting and Learning System (RLS). The data highlighted that for some kinds of medicines, such as antibiotics, anticoagulants and insulin, an omitted or delayed dose can have serious and even fatal consequences.

Many other research studies* have identified that omitted and delayed administration of medicines create risks to patient safety. Some examples of this research are outlined below.

Literature review

In a 2009 study, Green et al looked at omission errors on admission to acute medical wards². The study was carried out on two separate days; all the prescription charts for medical patients in a hospital on the audit days were reviewed and all medicines prescribed and not given in the first 48 hours were recorded, along with the reason given for omission. In total, 271 patient charts were analysed. Of these, 20 per cent of prescriptions affecting 17 per cent of patients had omitted doses. The main reasons for medicines not being administered to patients were that the medicine was not available on the ward (38 per cent of omissions), the patient was nil by mouth (32 per cent), or patient refused the medicine (10 per cent). In 19 per cent of cases there was no recorded reason for the omitted dose. The authors concluded that omitted doses could lead to increased morbidity and length of stay and that the current system that permits omission of medicine doses with inadequate justification must be revised.

A study by Thonse et al in 2004 helped to raise awareness of the problems associated with the prophylactic use of antibiotics, and in particular the timing of doses³. Surgeons in the trust where the study was undertaken were made more aware of the need to ensure that antibiotics are prescribed and administered according to the regimen. Nurses were also reminded of the importance of the timing of antibiotic administration and the methods to ensure timely administration.

A further study by Vogtander et al in 2004 showed that timely administration of the first dose, dosing intervals, dosage adjustment to renal function, and switch to oral administration of antibiotics are amenable for improvement in a hospital setting⁴. The study demonstrated that interventions supported by a multidisciplinary team, consisting of infectious diseases specialists, medical microbiologists, clinical pharmacists, nephrologists and nurses, leads to improvements of the process of care in administration of antibiotics.

Errors involving intravenous (IV) medicines are widely reported. In 2003, Wirtz et al found that in British hospitals the most common errors involving IV medication were caused by

* Note that there is a vast literature on this. Combined searching (10.12.09) in AMED, BNI, EMBASE, HMIC, MEDLINE, PsycINFO, CINAHL, HEALTH BUSINESS ELITE for (medication* OR medicine*) AND (omit* OR delay*) in the title or abstract produced 4642 publications since 2006. A slightly different search using the terms (drug* OR medic*) AND (omit* OR delay*) in the title or abstract produced 81241 publications since 2006. Therefore a few key papers (with high citation index) have been selected to illustrate the general problem.

omissions⁵. The authors recommended that these could be reduced if drug charts were read more carefully to check for newly prescribed IV medicines, and that better communication between prescriber, nurse and pharmacist could also reduce omissions.

In 2005, Rogers et al undertook a three-month audit to measure the effect of a gentamicin monitoring form on the compliance with gentamicin policy. The results showed, amongst other outcomes, that more than half of patients had doses omitted inappropriately during the study⁶, however, no clear data on frequency of omissions is given. Reasons for omissions included:

- Gentamicin level results were awaited before proceeding to the next dose (six patients), in contravention of policy.
- Lack of venous access (not quantified).
- No entry on drug chart: unclear whether given or omitted (not quantified).

A re-audit showed improvement in prescribing but more particularly in timing.

Further evidence of the danger of omitted antibiotics was highlighted in a 2004 audit of the performance of the percutaneous nephrostomy. The audit, which was carried out in a single, large hospital department, showed that omitted antibiotics led to sepsis in three patients⁷.

A 2009 report by the Care Quality Commission⁸, looked at the management of medicines following patients' discharge. The report published the results of a survey which showed that out of the 12 primary care trusts involved, 81 per cent stated that details of prescribed medicines were incomplete or inaccurate on discharge summaries "all" or "most" of the time. The report made recommendations to ensure that contracts with acute trusts set out the requirements and quality markers for both the timeliness and content of discharge summaries.

2. Review of evidence of harm

Table 1 below shows the clinical outcomes of incident reports of omitted or delayed medicine reported to the RLS between 29 September 2006 and 30 June 2009. (RLS datafields IN05=medication incident and MD02=omitted or delayed medicine[†]).

Table 1

Care Setting	Clinical Outcome of Incident Reports					Total
	Death	Severe Harm	Moderate Harm	Low Harm	No Harm	
Acute / general hospital	27	68	975	4,430	13,027	18,527
Community nursing, medical and therapy service (incl. community hospital)			67	239	1,211	1,517
Mental health service			33	150	1,156	1,339
Total	27	68	1075	4819	15394	21,383

3. Medicines reported as omitted or delayed that cause serious harm

Table 2 below shows the therapeutic groups associated with incident reports of omitted or delayed medicines, as reported to the RLS between 29 September 2006 and 30 June 2009.

Table 2

Therapeutic Group	Clinical outcome		Total
	Death	Severe harm	
Anti-infectives (Antibiotics and antifungals)	9	22	31
Anticoagulants	6	17	23
Resuscitation medicines	5		5
Insulin	2	1	3
Cardiovascular	1	3	4
Antiplatelets	1		1
Antiretrovirals		8	8
Anticonvulsants		3	3
Clotting agent		2	2
Proton Pump Inhibitor		2	2
Bronchodilators		1	1
Chemotherapy		1	1
Multiple		1	1
Oxygen		1	1
Steroid		1	1
Antagonist for respiratory depression	1		1
Immunoglobulin	1		1
Anticholinesterase		1	1

[†] Date of search: 10 October 2009. All incidents within the categorical field of omitted or delayed medicine were reviewed within the Reporting and Learning System database – no further keyword search was undertaken.

Therapeutic Group	Clinical outcome		Total
	Death	Severe harm	
Contraceptive		1	1
Diuretic		1	1
Human prothrombin complex concentrate		1	1
Recombinant urate oxidase		1	1
Unknown	1		1
Total	27	68	95

In addition there are incidents involving anti-parkinsons medicines where symptom control was significantly reduced by omitted or delayed doses. The Parkinsons Disease Society has launched a campaign called '[Get It On Time](#)' for hospital healthcare staff to reinforce the importance of patients with this disease receiving their medicines on time.

Best practice information, checklists and other resources are available for hospitals to ensure people with Parkinson's get their medication on time. Details of the campaign can be found on the Parkinson's Disease Society website at: www.parkinson.org.uk

4. Qualitative data

Below is list of example reports of omitted and delayed medicines.

Incident 1

Outcome - death

Medicine type – anti-infective

Cause – not given

Description – *'Patient admitted with infected ulcer and cellulitis. At 15.00hrs the doctor treating the patient instructed the nurse to give intravenous antibiotics immediately. The doctor returned at 16.30hrs - observations not done and antibiotics not given. Patient was drowsy. Nurse in-charge said she was too busy to listen. Staff nurse took manual blood pressure 70/40 - patient tachycardic. Patient had to go to Intensive Care Unit, where she died from severe sepsis.'*

Incident 2

Outcome - death

Medicine type – anti-coagulant

Cause – not given

Description – *'Diagnosed with pulmonary embolus. Stat dose of enoxaparin (Clexane) prescribed but does not appear to have been given. Patient arrested and died.'*

Incident 3

Outcome – death

Medicine type –anti-infective

Cause – route not available

Description – *'Patient did not receive amphotericin or flucytosine as prescribed. Patient did not have intravenous access as recommended. Patient died following transfer to another hospital.'*

Incident 4

Outcome – death

Medicine type - anticoagulant

Cause – not given

Description – *‘Transferred as emergency from ward straight to cath lab for coronary angiography with or without PCI. During the procedure a large thrombus in the left main stem was noted, at the same time it was noted that intravenous or intra arterial heparin had not been given. Cardiac arrest team were called, resuscitation non successful and patient died.’*

Incident 5

Outcome – death

Medicine type – insulin

Cause – failure to prescribe

Description – *‘Handed over patient had been without sliding scale since pm. She had been re-cannulated but was pulling this out. Blood sugars were climbing. Unable to re - establish if patient was eating or drinking - no record charts completed. Observations only recorded once. No as required Actrapid Insulin used. Patient deteriorated and died despite intervention.’*

Incident 6

Outcome – death

Medicine type – anti-infectives

Cause – failure to prescribe

Description – *‘Patient had known alcoholic liver disease, known renal failure and high blood potassium levels over the weekend but had not been checked or treated. Known sepsis but had not received appropriate antibiotics. Difficult fluid balance and plans for central line had not been pursued. Patient became asystolic.’*

Incident 7

Outcome – severe harm

Medicine type – anti-infective

Cause – medicine not available

Description – *‘The patient was on Tazocin. A mixed culture showed one isolate resistant to Tazocin. The patient’s antibiotic was changed to Meropenem. The first dose of Meropenem was only given 24 hours later as apparently it was sent to the wrong place. The patient was admitted to the ITU with sepsis.’*

Incident 8

Outcome - severe harm

Medicine type – insulin

Cause – medicine available not administered

Description – *‘At 16.40hrs a preregistration house officer received a call from ward regarding a patients clinical chemistry results. The potassium level was 6.9. Attended ward at 17.00hrs and prescribed salbutamol nebuliser, calcium resonium and actrapid insulin with Dextrose. On call phoned to repeat bloods at 19.00hrs. Attended this morning, patient arrested at 19.40hrs and from drug kardex prescribed medication was not given. Nursing staff were informed of prescription at 17.00hrs after doctor wrote it and were told it needed giving straight away.’*

Incident 9

Outcome – severe harm

Medicine type – anti-platelets

Cause – discharge medicines not supplied

Description – *'Patient had percutaneous Intervention. Patient and wife stated that the patient was not given any aspirin or clopidogrel on discharge but wife also said they had a long delay in discharge waiting for discharge medicines, delaying lift home so the discharge was rushed. The discharge medicines were not explained. The patient was readmitted with blocked stents.'*

Incident 10

Outcome – severe harm

Medicine type – chemotherapy

Cause – medicine not available out of hours

Description – *'Etoposide and Cisplatin not available to administer to patient on Saturday, pharmacist aware and will investigate. Not sent to ward on Friday, nobody noticed, shut over weekend.'*

Incident 11

Outcome – moderate harm

Medicine type – anti-Parkinsons

Cause – medicine not prescribed

Description – *'Patient unable to wake up from anaesthesia. Seen by anaesthetist. After one hour thirty minutes, ET tube removed patient very sleepy and muscle twitching. Very stiff and difficult to rouse. Patient has Parkinson's disease and is taking Sinemet.. Patient has not been prescribed Sinemet since arrival to hospital.'*

Incident 12

Outcome – moderate harm

Medicine type - anti-Parkinsons

Cause – medicine not administered

Description – *'Patient has very brittle Parkinson's disease. "Failed to wake" after operation . Ventilated on ICU. Noted 24 hours since last dose of all 3 anti-Parkinsons drugs. Became mobile and successfully extubated after ICU - given Sinemet 200+20.'*

5. Causes of omitted and delayed medicine incidents

The following themes have been identified following review of incident reports sent to the NPSA:

- intention to prescribe – not prescribed
 - new medicines or doses for a set course of medicine
 - routine regular medicine;
- medicine – not available – normal working hours;
- medicine – not available – out of hours;
- medicine – not administered;
- patient not on ward;
- unfamiliar preparation, administration, method or device;
- route of administration not available;
- medicine administered to wrong patient;
- discharge medicine not supplied.

The following sections provide some observations on possible causes and ways in which such risks can be minimised. These were considered as part of the consultation exercise with stakeholders (including the national Medication Safety Board) as practical ways in which risks could be minimised at a ward level, over and above the organisation-wide processes recommended in the RRR.

Medicines reconciliation

Medication errors, including those causing omitted and delayed medicines may occur at a number of stages during the hospital admission process, including when:

- determining the medication the patient is currently taking, from written records or the accounts of the patient, their families or carers;
- transcribing details of the patient's medication to the hospital clinical record;
- prescribing medication for the patient after admission.

The aim of medicines reconciliation on admission to hospital is to ensure that medicines prescribed on admission correspond to those that the patient was taking before admission. The National Institute for Health and Clinical Excellence and the NPSA issued a technical patient safety solution for the reconciliation of medicine in adult patients.⁹

Medicine 'not administered' codes

Inpatient prescription charts usually have a series of codes to use to record why a medicine has not been administered. There are usually codes for 'medicine not available', 'patient not on ward' and 'medicine refused'. A blank space in the administration record grid when a medicine should have been administered is usually considered unacceptable practice by ward staff. However, the use of a code indicating, for instance, that a medicine is not available may be used for several doses/days and may be considered acceptable practice. In addition to the requirement to record reasons for each omitted dose, it is important that guidance is given in local medicine management procedures. These should concern the need to escalate actions when a prescribed medicine has not been administered for two or more doses and every occasion when a critical medicine is omitted or significantly delayed.

'Stat medicines'

Prescribers often prescribe 'stat' one time doses to be administered outside of the normal medicines administration round times. Unless nursing staff are told verbally that a 'stat' dose has been prescribed, these new prescriptions may go unnoticed for several hours before they are identified during the next regular medicines administration round. It is the responsibility of the prescriber to verbally inform nursing staff that they have prescribed a 'stat' medicine, to enable the medicine to be administered in a timely manner.

Discharge medicines

If patients are sent home without a complete supply of their discharge medicines, this may increase the risk of medicines being omitted for several doses/days before a new supply is obtained. Medicine management procedures should clarify in what circumstances (if any) patients should be sent home without critical medicines. There should be systems in place to ensure that any critical discharge medicine which has been omitted is supplied in a timely manner. Also that escalated actions are identified in the event that a patient or relative does not return to hospital to collect medicines, or supply-chain problems continue to prevent the patient receiving their medicine.

Injectable medicines

Harms from injectable medicines account for over 60 per cent of all the serious incidents of all types, including omitted and delayed medicines, received by the NPSA. It is important to minimise the risks from the omission and delay of injectable medicines. Usually injectable medicines are prepared and administered at the end of the regular medicines ward rounds. This may cause long delays in their administration. Consideration should be given to administering injectable medicines at the beginning of regular medicines administration rounds and oral and other medicine doses only administered after the more important injectable medicines.

e-prescribing

The introduction of e-prescribing to the acute sector introduces further specific risks that could predispose omitted and delayed medicines. The nature of these risks is subtle and recognition of risks will become more apparent with time. Appendix 1 (page 11) lists those risks that are currently recognised in relation to omitted and delayed medicines with e-prescribing.

6. The Productive Ward

The NHS Institute of Innovation and Improvement has produced an initiative called *The Productive Ward: releasing time to care*, which comprises a number of separate modules including nursing procedures, ward rounds, patient observations and medicines administration. The module on medicines recommends ways to streamline medicines rounds and minimise interruptions to nurses performing ward round.

More information is available at:

www.institute.nhs.uk/quality_and_value/productive_ward/modules.html

7. Medicines management procedures

Medicines management procedures should include guidance on the following topics:

- medicine reconciliation on admission to hospital, on patient transfer between different clinical areas and on discharge from hospital;
- prescribing regular medicines;
- prescribing new medicines and stat doses;
- prescribing and reconciliation of medicines on discharge from medicines;
- availability in clinical areas of medicines that may be required to respond to an emergency;
- supply of ward/department stocks of regularly used medicines;
- supply of named patient medicines;
- supply of urgent supplies of medicine in hours and out of hours;
- use of patient own medicines;
- administering regular medicines;
- administering 'as required medicines';
- administering injectable medicines and infusions;
- timeliness of medicine administration;
- what to do if a dose of medicine is omitted or significantly delayed.

8. The timeliness of medicines administration

Medicine management procedures should include guidance on the timeliness of medicines administration. Individual NHS organisations should decide what this guidance should be to meet the needs of their patients.

In the summer of 2009, the NPSA conducted a stakeholder consultation of this RRR. Responses received indicated that the majority considered that most medicines should be administered plus or minus two hours from the time prescribed on the inpatient prescription. Stakeholders also identified some specific medicines and situations where administration should be much closer to the prescribed time or clinical indication. The examples suggested have been split into two groups as follows:

Group one:

- Resuscitation medicines including colloid or crystalloid IV fluids.
- First doses of injected anti-infectives.
- First doses of injected anticoagulants or thrombolytics.
- First dose of injected anticonvulsants including benzodiazepines.
- "Stat" doses of any medicine if the prescriber requires the dose to be administered before the next regular medicine administration round.

Group two:

- Insulin - linked to when food will be actually eaten.
- Strong analgesics.
- Bronchodilators.
- Glycerol trinitrate.
- Parkinson's disease medicines.

For some of the medicines in the second group, enabling inpatients to self-administer their own medicines at the most appropriate time is a practical approach, but may not be appropriate for all patients.

9. Summary

In summary the NPSA has a body of evidence for patient safety issues relating to omitted and delayed medicines. It proposes a staged approach to defining locally agreed critical medicines and developing systems to improve and audit the timeliness of administration. The association of specific medicines with patient harm has led it to highlight these for inclusion in all lists where these medicines are administered.

Appendix 2 (page 12) provides a rationale for each of the RRR actions. Appendix 3 (page 13) gives direction for compliance with the RRR.

Appendices

Appendix 1: e-prescribing

The introduction of e-prescribing and medicines administration systems introduces new risks to the administration of medicines and potentially magnifies existing ones. These need to be taken into account within those NHS organisations that have implemented these systems when implementing the RRR.

Prescribing risks

- The first dose of a medicine may be delayed. Systems will normally automatically schedule the time that doses are due to be given – when once or twice a day doses miss a scheduled time there may be delays of up to 23 or 11 hours respectively. Prescribers must be made aware of this automaticity during training.
- ‘Stat’ or give now doses – as with paper systems these may be missed by administering staff as systems may not automatically display them with the scheduled medicines. When these are prescribed, the prescriber must bring them to the attention of the staff who will be administering the medicine.
- Prescribers should be educated to ensure that they are aware that prescriptions using standard schedules will not necessarily meet need. For example where Parkinson’s disease patients require medicines at specific times these must be specified as such.

Administration risks

- Staff administering doses should be discouraged from using displays that do not show previous records of doses administered.
- Staff should be encouraged to use real-time system reporting functionality to identify where doses have been omitted, delayed or missed during shifts.
- Staff should be encouraged to interrogate systems for ‘stat’ doses.

Reporting risks

- The use of routine reports should be encouraged to monitor for problems. Non-specific reports may not be appropriate as there are many legitimate reasons why doses are omitted – the noise may mask underlying problems. Where possible reporting should focus on known critical medicines or specific reasons given for missed doses.
- Consideration should also be given to generating reports that demonstrate the delays that occur between prescription and first dose for critical medicines.

System configuration

- Systems should be configured to show doses as being overdue when they are beyond locally defined time limits.
- Where delays of up to five hours before scheduled administration will occur following a prescription, systems should remind prescribers that an intermediate dose may be required.
- Administration views should highlight where previous doses have been omitted or delayed.
- The ability to tailor and generate reports and define alerts highlighting delays in critical medicines must be supported.

Appendix 2: Summary of rationale for recommended actions

This table provides a summary of how the incident reports, local policy review, and literature explored above informed our recommended actions.

Number	Recommendation	Summary of rationale
1	Identify a local list of critical medicines where timeliness of administration is crucial. This list should include anti-infectives, anticoagulants, insulin, resuscitation medicines and medicines for Parkinson's disease, and other medicines identified locally.	<p>Critical medicines are those where the omission or delay is likely to cause the most harm. The NPSA has identified four critical medicines where two or more fatal incidents have been reported. In addition we have identified medicines to treat Parkinson's disease as a critical medicine.</p> <p>Parkinson's is an important chronic condition where timeliness of drug therapy matters. This guidance can add impact by reinforcing an existing campaign, with useful resources for staff.</p> <p>After a wide consultation with stakeholders, a national list of critical medicines was not recommended. This was because medicines considered critical in one hospital (for example a children's hospital) may differ significantly from another hospital, such as a cancer hospital or mental health hospital.</p> <p>The answer was to provide flexibility for NHS organisations to identify a list of critical medicines that address local risks and add these to the list proposed by the NPSA.</p>
2	Ensure medicine management procedures include guidance on the importance of prescribing, supplying and administering critical medicines, timeliness issues and what to do when a medicine has been omitted or delayed.	<p>This action provides front line staff with guidance on local procedures to minimise harm from omitted and delayed critical medicines.</p>
3	Review and, where necessary, make changes to systems for the supply of critical medicines within and out-of-hours to minimise risks.	<p>Analysis of incidents by the NPSA has identified there may be significant delays in clinical areas receiving urgent supplies of critical medicines from the hospital pharmacy during normal working hours and either from the pharmacy or emergency medicines cupboard out of hours. A responsive system for supply of urgent medicines should be in operation to meet the clinical needs of patients.</p>
4	Review incident reports regularly and carry out an annual audit of omitted and delayed critical medicines. Ensure that system improvements to reduce harms from omitted and delayed medicines are made. This information should be included in the organisation's annual medication safety report.	<p>It is only by reporting and reviewing incident data and taking action that these risks will be effectively managed over the long term. Providing this information in an annual report communicates how this risk is being managed on an ongoing basis in organisations.</p>
5	Make all staff aware (by wide distribution of this RRR) that omission or delay of critical medicines, for inpatients or on discharge from hospital, are patient safety incidents and should be reported.	<p>Errors of omission and delay of treatment with critical medicines are frequent and may not be considered as patient safety incidents that can lead to serious harm or death. Circulating the RRR helps to clarify the need to report and take action to reduce the risks with these types of incidents.</p>

Appendix 3: Suggested compliance checklist

Number	Recommendation	Action	Y/N
1	Identify a local list of critical medicines where timeliness of administration is crucial. This list should include anti-infectives, anticoagulants, insulin, resuscitation medicines and medicines for Parkinson's disease, and other medicines identified locally.	Record of the process for developing the list of critical medicines, formal approval and distribution of the critical medicines list.	
2	Ensure medicine management procedures include guidance on the importance of prescribing, supplying and administering critical medicines, timeliness issues and what to do when a medicine has been omitted or delayed.	Record of review of medicine management procedure and any approved changes by an organisational committee has been documented. Record of internal distribution of amended procedures.	
3	Review and, where necessary, make changes to systems for the supply of critical medicines within and out-of-hours to minimise risks.	Record of the review of medicine management procedure and any approved changes by an organisational committee has been documented. Record of internal distribution of amended procedures.	
4	Review incident reports regularly and carry out an annual audit of omitted and delayed critical medicines. Ensure that system improvements to reduce harms from omitted and delayed medicines are made. This information should be included in the organisations annual medication safety report.	Record of review of incident reports, audit and actions as agenda items on the medication safety group. Annual audit and inclusion in the organisation's annual medicines management report.	
5	Make all staff aware (by wide distribution of this RRR) that omission or delay of critical medicines, for inpatients or on discharge from hospital, are patient safety incidents and should be reported.	Record of internal distribution of the NPSA RRR throughout organisation.	

References

1. National Patient safety Agency. *Safety in Doses. Improving the use of medicines in the NHS 2009*. NPSA, 2009. Available at: <http://www.nrls.npsa.nhs.uk/resources/?entryid45=61625> (accessed 24 February 2010)
2. Green Cj, Du-Pre P, Elahi N, Dunckley P, McIntyre AS. Omission after admission: failure in prescribed medications being given to inpatients. *Clin Med* 2009; 9: 515-8
3. Thonse R, Sreenivas M, Sherman K. Timing of antibiotic prophylaxis in surgery for adult hip fracture. *Ann R Coll Surg Engl* 2004; 86: 263–266
4. Vogtander NP, Van Kasteren ME, Natsch S, Kullberg BJ, Hekster YA, Van Der Meer JW. Improving the Process of Antibiotic Therapy in Daily Practice: Interventions to Optimize Timing, Dosage Adjustment to Renal Function, and Switch Therapy. *Arch Intern Med* 2004;164: 1206-12
5. Wirtz V, Taxis K, Barber N. An Observational study of intravenous medication errors in the United Kingdom and in Germany. *Pharm World Sci* 2003; 25: 104-111
6. Rogers MS, Cullen MM, Boxall EM, Chadwick PR. Improved compliance with a gentamicin prescribing policy after introduction of a monitoring form. *Journal of Antimicrobial Chemotherapy* 2005; 56(3), 566-568
7. Lewis, S and Patel, U. Major complications after percutaneous nephrostomy: lessons from a departmental audit. *Clinical radiology* 2004; 59: 171-9
8. Care Quality Commission. *Managing medicines after discharge*. CQC, 2009. Available at: http://www.cqc.org.uk/db/documents/managing_patients_medicines_after_discharge_from_hospital.pdf (accessed 4 February 2010)