Feasibility study of multicentre comparison of NHS hospital pharmacy computer data

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Aims This study aims to determine the feasibility of collecting, collating and analysing drug expenditure data from a sample of acute hospitals in England.

Methods The hospital pharmacy computer system was used to report on drug expenditure from 16 hospitals throughout England for a 2 year period. These data were analysed as a whole and hospital episode statistics were correlated to hospital drug costs.

Results Hospital outpatient costs were found to be approximately one third of hospital inpatient costs. Cardiovascular drugs accounted for the greatest increase in expenditure for both inpatients and outpatients (25%). The most expensive therapeutic area of drug use across all sites was anti-infectives. The average daily number of occupied beds explained 55% of the variation in inpatient expenditure and the number of outpatient (including Accident and Emergency) attendances explained 60% of the outpatient drug expenditure.

Conclusions This project has confirmed the feasibility of collecting, collating and analysing hospital drug expenditure and identified some interesting patterns and trends in hospital drug use. Hospital activity is reflected in hospital drug costs.

Keywords: computer, hospital, pharmacy, prescribing

Introduction

Prescribing Analysis and Cost (PACT) data provide detailed information on the prescribing patterns of every general practice [1], allowing external and internal analysis and management of the community UK National Health Service (NHS) drugs bill as a whole. Hospital prescribing accounts for about 20% of the total NHS drugs bill, around £800 m per annum [2]. This requires strong internal management in hospitals, based on detailed information from the pharmacy computer system. But in contrast to primary care, where all community prescriptions are entered onto a single database, hospital pharmacy computer systems do not share data, preventing external comparison. There are many different hospital pharmacy computer systems in use throughout England, with little or no cross compatibility, and widely varying reporting

capabilities. They are generally used for internal drug stock control and ordering.

Hospital managers have a cash-limited allocation of funds and must decide how this is to be divided among the various patient services, including the provision of drugs. However, the drug bill is less easy to control than many other parts of the hospital budget, leading to tensions within hospitals and at the interface between secondary and primary care and allegations of cost shifting by hospitals [3]. Hospitals in the UK generally have a Drugs and Therapeutics Committee, responsible for determining the hospital formulary and a clinical pharmacy service to encourage good prescribing and adherence to local prescribing policies such as formularies [4]. There is no benchmarking of the performance of either prescribers in hospital, nor of hospitals in managing their prescribing or their drug bill. The evolution of clinical governance and the necessity to monitor performance against standards, and the creation of a single unified budget in primary care groups to cover both hospital and primary care services, will demand suitable comparative data to address these points [5]. Some data on hospital drug use are collected by a commercial company, and sold (for profit) to a range of

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interested parties; these data are not generally available to the NHS.

There is therefore very little information on the global picture of prescribing in hospitals in the NHS, its trends or costs. Such information might improve the management and planning of drug use across the NHS, particularly with the advent of the unified cash-limited healthcare budget [6].

We wished to test the feasibility of regularly collecting, collating and analysing prescribing data from a sample of acute hospitals in England, using the data that can be provided by most current hospital pharmacy computer systems.

Methods

Participants

A questionnaire was sent to all general hospitals in England concerning their computer systems and inviting them to take part in the feasibility study of downloading data from hospitals. Based on these replies, inclusion criteria for hospitals to enter the study were drawn up: these were that the sites should be general hospitals, with a wide geographical spread across England, that the dispensary computer system was used for stock control, that participating hospitals must commit to produce monthly reports in an agreed electronic format, and that the hospitals would use one of four common computer systems (J.A.C., M.D.I.S., Cortex or Trent). The largest hospitals meeting these criteria were included. Specialist only hospitals were specifically excluded, as their budgets might have been excessively biased by one drug group. No funding was provided to the hospitals.

A convenience sample of hospitals meeting these criteria were selected, based on geographical spread, an annual drug budget greater than £3.5 million, and an assessment of their ability and enthusiasm to provide the data. Ten hospitals were selected as major research sites and a further 10 as minor sites: the differences between the two being that the major sites were asked to provide full data (see below) and the minor more limited data. The 'minor' sites served to increase the size of the database for key measures and to provide a contingency 'site pool' in the event of any of the major hospitals being unable to deliver the data required.

Each of the major sites was visited (by PDW) to assess the capability of their computer systems and to discuss on-site variations in practice affecting reporting parameters, such as system configuration, ability to distinguish inpatient from outpatient usage and the format of reports required.

Data

The data collected were limited to expenditure on medicines: total spending on drugs by each hospital and broken down further to British National Formulary (BNF) chapter and section headings, and by inpatient or outpatient use from all hospitals. Data for some specific drugs were collected also from the 10 main sites. Initial plans to collate data on the volume of drug issued were abandoned, since hospitals were unable to provide consistent information on this. Data were collected for each 3 month quarter from January 1997 to March 1999.

Data were received on floppy disk in various file formats, and were imported for processing into Microsoft Excel and Access. No formal statistical analysis was undertaken.

Data concerning levels of various indicators of hospital activity for each of the study sites were taken from NHS Hospital Episode Statistics [7] for the period April 1997 to March 1998. Hospital costs for the period were correlated to measures of hospital activity.

Results

Questionnaire

The questionnaire was sent to 250 sites. 125 (50%) replied, and all expressed a wish to be included in the project. 70 (56%) responding hospitals indicated they could meet each of the major entry criteria. Seventeen different hospital pharmacy computer systems were in use: four (J.A.C., M.D.I.S., Cortex and Trent) covered 63% of the total.

Feasibility/Problems

On-site discussions highlighted and resolved various practical difficulties both before and during the project. These are summarized in Table 1.

Of the 20 selected hospitals, one major site proved unable to deliver the data on floppy disc despite support from PDW, and was excluded from further study. Anonymised details of the 19 participants are shown in Table 2. Hospitals F, J and M provided data only for 1 calendar year (1997) and are therefore excluded from the year on year comparisons.

Expenditure

The inpatient expenditure for the financial year 1997/98 was £90.7 million, whereas the outpatient expenditure was about one third of this at £30.6 million. In-patient expenditure was generally greater than outpatient expenditure in every BNF chapter. Exceptions to this were, for instance, hospital M with a large outpatient HIV

Table 1 Problems and solutions in hospital pharmacy data collection and processing.

<i>Problem</i>	<i>Solutions</i>
1a Advance problems	
<i>System configuration</i> Drugs stored in different sites within the same hospital – internal transfers between sites included as transactions in pharmacy computer.	System configurations examined and discussed transactions resulting in an issue of drugs to a patient (including ward stock items) were included.
<i>Other 'purchasers'</i> Some hospitals provide services to outside units such as hospices.	Drug issues to these units excluded from the reports.
<i>Extemporaneous products</i> Raw materials used in the preparation of these products as well as final product included in pharmacy computer – double counting.	Only costs associated with the issue of the final 'new' product to the patient were included in project reports.
<i>Definitions</i> Poor definition of split between inpatient and outpatient drug use., e.g. how to handle 'Day case' or 'Day Hospital' patients? Some hospitals also dispensing 1 or 2 week's supply of drugs to inpatients upon admission for use both as an inpatient and after discharge.	Tight definitions of 'inpatient' and 'outpatient' issue for the purposes of the project: inpatient was anything used whilst the patient was in hospital; outpatient was anything for patient's use at home. Some blurring of the margins of these are likely in practice.
1b Developing problems	
<i>Data on disk</i> Some sites, although theoretically capable of producing reports on disk, found this difficult in practice, due to deficiencies in the system software, lack of relevant computer skills, lack of support from the computer supplier.	Training and advice were offered to several sites.
<i>Data formats</i> Data provided in a variety of formats, due to the different reporting capabilities of the four computer systems, different software versions of the same computer system, customization of nonstandard reports and the structuring of the drug and data files by individual users to suit their working practices.	Some data required substantial manipulation before it could be imported into the database. A procedure was drawn up for each hospital detailing the data handling method.
<i>B.N.F. classifications</i> Lack of standardization in recording of BNF classifications, e.g. 2.011 New BNF sections 'invented' (e.g. 7:06) to allow undefined data to be coded within the correct BNF chapter, or new 'chapters' created to classify items not included in the BNF coding structure, e.g. bags, bottles.	Data cleaned manually. Products classified into newly created section or chapter 'extras' as appropriate. These 'extras' accounted for almost 10% of overall hospital drug expenditure
<i>Drug names</i> Non-standard names used, e.g. Dornase Alpha may be listed as DNase or Pulmozyme.	Manual searching and correction of the files.

department where outpatient expenditure on BNF chapter 5:03 (antivirals) during 1997 was more than 7 times that of the inpatient expenditure.

These total costs increased by approximately £11 million (9.2%) between the financial years 1997/8 and 1998/9 (Table 3). Hospitals varied in the changes over this

Table 2 Study Hospital Statistics for Financial Year 1997–98. ('major' sites A–I, 'minor' J–S).

Hospital	1997/98 Total Expenditure (£)	Available beds	Occupied beds/day	% bed occupancy	Number of completed consultant episodes	Number of clinic attendances (including A & E)
A	4089991	364	319	87.4	21463	174755
B	5409081	538	435	80.8	36940	229218
C	2307711	389	332	85.4	35693	278034
D	4428534	919	709	77.2	73951	402201
E	8272509	973	867	89.1	45246	262185
F *	Not available	1036	789	76.1	70448	329132
G	7007453	993	853	85.9	55569	365390
H	9639619	944	790	83.7	48261	366945
I	2544182	513	404	78.7	31293	201988
J *	Not available	722	571	79	55179	431114
K	7206229	874	635	72.7	82028	463248
L	9364769	1361	1008	74	80718	367122
M *	Not available	658	649	98.6	40752	380254
N	16281463	1067	812	76.1	70330	635709
O	5685032	630	564	89.5	52009	296102
P	11014341	1156	1069	92.5	64549	528952
Q	7155692	1007	773	76.8	79138	546323
R	8926528	813	590	72.5	55412	451330
S	11975428	1436	1087	75.7	73443	603730

* withdrew from the project at the end of the first year.

period: the median increase was 10.3% (minimum –2%, maximum +35%) Inpatient costs increased by a total of £7.7 million (8.4%: median increase 9.3%, minimum –8%, and maximum of +42%). Outpatient expenditure

Table 3 Total expenditure during 1997/98 and 1998/99 (All project sites).

BNF chapter	Total expenditure 1997/98	Total expenditure 1998/99	% increase
1 Gastrointestinal	2556582	2554791	0
2 Cardiovascular	11580521	14514156	25
3 Respiratory	2917138	2947002	1
4 CNS	10738148	12268691	14
5 Anti-infectives	23470396	25655975	9
6 Endocrine	5279008	5650398	7
7 Gynaecology and urinary	2225910	2535384	14
8 Malignant disease and immunosuppression	11375228	12931920	14
9 Nutrition and blood	16279994	17712089	9
10 Musculoskeletal	1048110	1139016	9
11 Eye	2414278	2449832	1
12 ENT	574670	568612	–1
13 Dermatology	6063446	6070911	0
14 Vaccines	3361573	3622641	8
15 Anaesthetics	8073756	8417290	4
'Extras' (i.e. not BNF classified)	13349805	13444304	1
Total	121308563	132483011	9

increased by £3.5 million (11.5%, median of 13.7%, minimum –16% and maximum +58%).

BNF Chapter 2 (cardiovascular) accounted for the greatest percentage increases in both inpatient and outpatient (25%: median 18% with minimum +6.9% and maximum +95%); for outpatients, BNF chapter 5 (anti-infectives) was also a major area of increase (23%: median 19% with min –17% – max +79%) (Table 2).

The most expensive area of drug use across all sites was anti-infectives (Table 3, BNF Chapter 5). Within this group, the majority of inpatient spending during financial year 1997/98 (76%) was on BNF section 5.1 (antibacterials). Individual antibiotics were also examined in the major study sites: seven drugs accounted for 61% of inpatient spend. In decreasing order of cost, these were ciprofloxacin, teicoplanin, cefuroxime, cefotaxime, ceftazidime, coamoxyclov and flucloxacillin. In contrast, for outpatients, it was section 5:03 (Antiviral drugs) which accounted for the largest proportion (57%) of these costs – largely explained by HIV services.

Standardization

In an attempt to compare individual hospital's expenditure, a range of possible denominators such as occupied bed days or completed consultant episodes were correlated with costs of inpatient prescribing (Figure 1), and outpatient attendances for costs of outpatient prescribing (Figure 2). Of the denominators studied, the average daily

number of occupied beds gave the best correlation with hospital costs (Figure 1), explaining 55% of the variance. One hospital was a clear outlier. For outpatients, there was a good correlation to outpatient attendances (including accident and emergency departments), with these explaining 60% of the variance in costs (Figure 2). For a 700 bed hospital, average expenditure per occupied bed day was £22.14 (95% CI £17.71, £26.57).

Discussion

The project has succeeded in amalgamating drug use data for 2 years from several different hospitals using various computer systems, defining for the first time the major areas of drug expenditure on inpatients and outpatients across a range of hospitals and allowing consideration of trends in prescribing costs. The actual numerical results obtained need to be interpreted with some caution, given that the hospitals studied represent a small convenience sample and not a census nor a large randomised sample. These data may however, prove useful in determining some of the cost drivers for hospital prescribing. Many problems were encountered which need to be resolved before this project could be extended to provide national coverage. Some of these are technical, related to computer and recording systems, and some are conceptual such as how the data can be standardized to allow comparisons across different hospitals with different specialities, activities and case mix, and indeed whether the data with its emphasis on costs is of value at all, other than for basic budget management.

These data were presented to hospital chief pharmacists,

health authority prescribing advisers and the NHS Executive. All were enthusiastic about comparative data for benchmarking; they wanted more detailed data, e.g. information on specific drugs/drug groups, comprehensive data from all hospitals across the country, and the development of an electronic database for interrogation by individual users.

Technical issues

Clearly, the specification and production of a standard set of simple reports would simplify the processing of these data enormously. The format of the report could be specified by NHS in consultation with computer suppliers and end users of the data. The ability to produce such a defined report might be part of the required specification for hospital computer procurement in the NHS. This whole area is currently in turmoil with few companies competing for NHS contracts and a poor history of NHS initiated computer projects.

A standard product identifier is required for use in hospital pharmacy systems. This coding would also need to cover the 'Extras' more accurately, e.g. a code for peritoneal dialysis fluids. The Prescription Pricing Authority (PPA) already has such a coding system for primary care prescribing, which could be adopted for this purpose. This would avoid problems with different codes and the need to use drug name identifiers, which required a major effort in the current study. The PPA codes define product and pack size, and could allow better data on volume usage as well as expenditure: one of the problems preventing use of volume data in the current study was

Figure 1 Inpatient expenditure *vs* average daily number of occupied beds for financial year 1997–98 (showing 95% confidence intervals).

Figure 2 Outpatient expenditure *vs* consultant outpatient activity, including A & E attendances for financial year 1997–98 (showing 95% confidence intervals).

varying definitions of pack size and issue units in different hospital computer systems. Special provision would be needed in such a code to include packs that are prepared by individual hospitals.

The collection of the data in the current study was done voluntarily by the hospital pharmacies. There was limited ability therefore to ask for better preparation of its reports or to request further details. Lack of staff training in information technology exacerbated this. If this project were to be extended, sufficient local resources for the collection of data and quality assurance would be needed. Standardization of pharmacy computer systems and electronic transfer of data from the sites via the NHS net could reduce the workload substantially.

Conceptual

Data from different sized hospitals, with diverse specialities and case mix, cannot easily be compared. Attempts to measure hospital activities in a standardized way have so far been poor – the weakness of the completed consultant episode have been clear [8]. Nevertheless, using very simple measures of hospital activity as denominator explained 55–60% of the variance in costs: more detailed work looking at individual BNF chapters and areas of activity may allow this to be refined. This problem of a suitable denominator has been tackled in primary care prescribing with the development of sophisticated measures as the Age Sex and Temporary Resident originated prescribing unit (ASTRO-PU) [9], and the Specific Therapeutic Area Related-PU (STAR-PU) [10]. It

might be possible to develop hospital ‘prescribing units’ for each major therapeutic area, e.g. medical, geriatric, surgical or even more detailed to cardiology, respiratory medicine, nephrology, etc. Variations due to local morbidity and deprivation could also be factored in to such denominators [11]. In the US, diagnosis related group costs [12] have been calculated for most illnesses and hospitals may be paid on this basis. Although these are controversial, a similar measure for drug costs could be developed in the UK according to patient diagnosis, and applied to the hospital case mix.

An extensive program of research would be required to achieve this and since the data to which the results would be applied are weak, their value is uncertain; for instance, ASTRO-PUs or STAR-PUs are applied to the defined age and sex structure of a practice list held at the health authorities – such data are of relatively poor quality in many hospitals. Given that hospitals operate fixed rather than needs based budgets for their drug use, the value of such data and the effort required to create it might be questioned.

In the current project, it is not surprising that hospital activity as measured by average daily number of occupied beds or outpatient attendances should correlate with relevant pharmacy costs, although this has not to our knowledge been shown previously. The one outlier weakened the correlation, but despite this, the strength of the correlation suggests that such data could be used to benchmark hospital drug costs for management purposes. Further work to refine the correlation between specific classes of drugs and specific diagnoses is also possible.

Other developments of the current project

We are now attempting to measure volume of drug use in defined daily doses based on the data about packs issued by pharmacies. In theory it might be possible to calculate volume data from expenditure by looking at the list price for a given volume of drug and the total amount spent, but this is undermined by the often confidential prices a hospital has negotiated with a supplier. Such data might be used to criticise the contracting process in a hospital pharmacy for paying more than another hospital for a DDD of a particular drug, while ignoring that a hospital might accept a high price on a little used drug in exchange for a low price on a more widely used medicine. More sharing of these data would encourage hospitals to form co-operatives obtaining a cheaper price on their little used drug whilst maintaining a good deal on their other items.

Another extension to this study is to consider the prescribing of items on FP10(HP) forms that are issued by a hospital for dispensing by a community pharmacist – a means to reduce hospital pharmacy workload when the pharmacy is ‘over-stretched’, to obtain ‘non-formulary’ drugs or to avoid VAT on dispensed medicines. These costs are ultimately recharged to the issuing hospital, and information on these prescriptions is needed to complete the overview of hospital prescribing.

This project has confirmed the feasibility of collecting routine hospital data and has identified some interesting patterns and trends in hospital drug use. It is clear that managers both in hospital and in health authorities and possibly also in PCGs would welcome this data, if it can be collected easily and in a standard format with due attention to quality assurance. Many difficulties have been identified, but all are surmountable with appropriate support.

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