Cooke, Richard <r.cooke@aston.ac.uk>Cooke, Richard <r.cooke@aston.ac.uk>Development of a prescribing indicator for objective quantification of antibiotic usage in secondary care.

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Abstract

Objectives

To compare the recognised Defined Daily Dose per 100 bedday measure (DDD/100 bedday) with the Defined Daily Dose per Finished Consultant Episode (DDD/FCE) in a group of hospitals with a variety of medicines management strategies.

To compare antibiotic usage using the above indicators in hospitals with and without electronic prescribing systems.

Methods

Twelve hospitals were used in the study. Nine hospitals were selected and split into three cohorts (three high-scoring, three medium-scoring and three low-scoring) by their 2001 Medicines Management self-assessment scores (MMAS). An additional cohort of three electronic prescribing hospitals was included for comparison. MMAS were compared to Antibiotic Management Scores (AMS) developed from a questionnaire relating specifically to control of antibiotics. FCEs and occupied beddays were obtained from published statistics and statistical analysis of the DDD/100 beddays and DDD/FCE were carried out using SPSS.

Results

The DDD/100 beddays varied from 81.33 to 189.37 whilst the DDD/FCE varied from 2.88 to 7.43. The two indicators showed a high degree of correlation r = 0.74. MMAS were from 9 to 22 (possible range 0 to 23) and the AMS from 2 to 13 (possible range 0 to 22). The two scores showed a high degree of correlation r = 0.74. No correlation was established between either indicator and either score.

Conclusions

The WHO indicator for medicines utilisation, DDD/100 beddays, exhibited the same level of conformity as that exhibited from the use of the DDD/FCE indicating that the DDD/FCE is a useful additional indicator for identifying hospitals which require further study.

The MMAS can be assumed to be an accurate guide to antibiotic medicines management controls.

No relationship has been found between a high degree of medicines management control and the quantity of antibiotic prescribed.

Keywords

Antibiotic usage, Defined Daily Dose, prescribing indicator, secondary care.

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Introduction

It has been estimated[1] that twenty per cent of medicines expenditure in England occurs in secondary care. However, there is little aggregated data relating to the use of medicines in this sector. Pilot work,[2] found that during the period between January 1997 and December 1998, antibiotics accounted for nineteen per cent of the total expenditure on medicines in secondary care, which was the highest spend of all categories of medicinal product. Participants within the study also highlighted that there was a need for a suitable indicator to facilitate benchmarking between hospitals.

The emergence of ‘evidence based practice’ during the NHS policy reforms of the 1990s was part of the change to create a culture in which clinical governance drives individual hospital practitioners to examine their practice and compare it with their peers. Pharmaceutical care, ‘the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient’s quality of life’[3] defines the scope of pharmaceutical responsibility in the use of medicines. This was supplemented by the ‘medicines management’ concept,[4] which developed the theme of systems to control medicines usage from procurement, managed entry onto a hospital formulary through to prescribing review and use of clinical guidelines. In order to optimise the use of medicines, it is vital that therapeutic categories of medicines where there is high-volume and high-cost are reviewed. It has been established that antibiotics are often both high-volume and high-cost. In addition, it has been demonstrated[5] that a large percentage of antibiotic use in hospitals is inappropriate.

Clearly, there is a requirement for multi-centre clinical audit of antibiotic usage. However, in order to benchmark the use of antibiotics across the full spectrum of secondary care settings, a robust measure is needed which is independent of workload, in order that comparisons can be made. The UK Department of Health has recently allocated funding for each English hospital to use for promoting 'prudent use of antibiotics'.[6] This initiative will enable work to commence to improve targeted clinical pharmacy initiatives related to antibiotic use and also to begin to address collection of data from hospitals.

A large amount of therapeutic guidance[7-12] has been published, which focuses on antibiotic resistance and the use of antibiotics in medicine. Issues examined include the use of formularies within hospitals, the process by which antibiotics are prescribed by junior doctors, sensitivity testing and the surveillance of resistant organisms. One report[13] concluded that there was a lack of data on antimicrobial use in hospitals and that hospitals should install computerised systems for patient specific prescribing.

The European Society for Clinical Microbiology and Infectious Disease (ESCMID) established a study group on antibiotic policies (ESGAP) which in turn created a number of sub-groups to develop strategy related to the stewardship of antibiotics within European hospitals. This group produced a number of recommendations[14] which include a commendation that 'measurement of antibiotic consumption should be performed with regular benchmarking of figures and discussion between prescribers, pharmacists and infection specialists'.

The purpose of any indicator of prescribing is to enable comparisons to be made over time. The comparison may be between individual prescribers, wards, specialties, hospitals or geographical groups of hospitals. Measures are not definitive but act as a focus for the commencement of review and should act as a stimulus for change.

The need for an international classification system for drugs has been recognised for many years.[15] The Anatomical Therapeutic Chemical System (ATC), was developed by the Norwegian Medicinal Depot, in Oslo, by modification of an existing system that had been used by pharmaceutical market researchers in Europe. In addition to a robust classification system it was necessary to develop a unit of measurement. The Defined Daily Dose (DDD) was developed, also by the Norwegian Medicinal Depot as a unit of measurement for use in drug utilisation studies. The ATC/DDD system, was recommended for international drug utilisation studies by the World Health Organisation (WHO) in 1981. The purpose of the ATC/DDD system is to act as a tool for drug utilisation research so that the quality of drug usage will improve.

The DDD is defined[16] as 'the assumed average maintenance dose per day for a drug used for its main indication in adults'. A DDD is only assigned when a compound has been given an ATC code. All of the ATC codes and DDD data are published in the ATC Index.[17] The DDD is not a reflection of a prescribed or recommended daily dose. It represents a unit of measurement to enable researchers to identify trends in consumption of medicines and to compare the exposure to specific medicines of population groups. The DDD is a compromise in that it is based on a review of doses used in a variety of countries. The DDD will normally be associated with a denominator to correct for workload variations. For hospital in-patients the number of DDDs per 100 beddays is normally used.

A study of the DDD system[18] compared the approach of Europeans to undertaking drug utilisation review with that of the North Americans which has focussed more on review of individual prescribers and individual drug regimens in order to optimise patient treatments.

This study concluded that the DDD system would serve as a valuable additional tool for drug utilisation studies. A further study carried out to evaluate DDD methodology[19] concluded that calculation of the DDD was a valuable first step in measuring total drug use in a population, but that for more precise estimates of drug use, other techniques would also be required.

An antibiotic usage measure developed in 1998 within our group[20] has been applied previously to the usage of quinolone antibiotics. In order to more fully evaluate the usefulness of this measure as a tool to compare antibiotic utilisation, the present study compares the recognised DDD/100 bedday measure with the DDD/FCE in a group of hospitals with a variety of medicines management strategies.

Materials and method

Four cohorts of three hospitals were used as data collection sites. These hospitals were selected for their differing inter-group characteristics, in terms of size, workload, case-mix and medicines management strategy. The sample size was 6.65% of hospital activity in England based on the total number of FCEs completed in the year 2001/2

(822,445 FCEs from a total of 12,357,360; data obtained from Hospital Episode Statistics 2001/2 Department of Health, London). A Finished Consultant Episode (FCE) being defined as 'a period of healthcare under one Consultant, in one hospital provider'.[21]

Antibiotic usage data was collected for systemic antibacterials (ATC category J01).

The number of occupied beddays and FCEs for each Trust for 2001/2 was recorded from the Department of Health published Hospital Episode Statistics.

The hospitals were selected on the basis of their medicines management self-assessment scores arising from a nationally sponsored self-assessment exercise carried out at the beginning of 2001.[22] This self-assessment consisted of six equally weighted domains of activity related to medicines management, with a high score being indicative of a high degree of control of medicines usage. The maximum possible aggregate score was 23. The six-domains were as follows –

- Senior management awareness and involvement
- Information and financial issues
- Medicines policy management, including the introduction of new drugs
- Procurement of medicines
- The primary and secondary care interface
- Influencing prescribers

It was felt that the scores from this exercise would be indicative of the degree of control and influence over the general use of medicines and more specifically, antibiotics, and that high scores in this measure would be linked to low levels of antibiotic usage (divergent validity).

Reviewing the scores for hospitals in the West Midlands, it was possible to select three high-scoring hospitals (score >19), together with three medium scoring hospitals (score >15 but < 19) and a third group with lower scores (score <15).

In addition, to these nine hospitals it was felt that the three English hospitals that have fully implemented electronic prescribing systems would be used as a discrete comparator reflecting the potential importance of electronic prescribing systems in controlling medicines usage. The characteristics of the hospital trusts participating in the present study are summarised in Table 1.

In order to validate the medicines management scores which relate to general control systems in place for all medicines, a questionnaire was designed containing questions covering 11 aspects of medicines management relating specifically to control of the use of antibiotics. This ensured consistency in interpretation of the questions across the sample. The data generated from the questionnaire would also support and cross-reference the results from the medicines management self-assessment tool. The questions covered areas of recognised good practice in control of antibiotic usage and included – audit of usage, data sharing between pharmacy and microbiology departments, liaison with Infection Control services, pharmacy led educational initiatives, pharmacist empowerment to convert from IV to oral routes, pharmacist discontinuation of therapy and rationalisation of formulary choices of antibiotics.
The maximum possible score for this assessment was 22.

Statistical treatments

Data was entered into a flatfield database and analysed using the SPSS version 11 software package.

Results

Table 2 lists each Trust included in the present study with details of activity, the total number of DDDs of antibiotic used in 2001/2 and the derived prescribing indicators and Medicines Management scores.

The range of Medicines Management scores was from 9 to 22 and the Antibiotic Management Scores ranged from 2 to 13. The DDD/100 beddays varied from 81.33 to 189.37 (mean 114.62). The DDD/FCE varied from 2.88 to 7.43 (mean 4.1).

Figure 1 shows the correlation of the two prescribing indicators (Pearson correlation r = 0.74). Figure 2 shows the correlation of the medicines management scores (Pearson correlation r = 0.74).

Discussion

The present study has evaluated the performance of two prescribing indicators, one established, the other experimental, in assessing antibiotic prescribing in a range of UK hospital trusts. The DDD/FCE and DDD/100 bedday results did show a significant correlation (r = 0.74). It was felt that this demonstrated the robustness of the proposed indicator as an additional measure for use when antibiotic drug utilisation studies are being carried out. This in turn facilitates the identification of hospitals where more detailed or specialised analysis of antibiotic prescribing is required.

The electronic prescribing group had the lowest mean usage 3.5 DDD/FCE. It is likely that the use of a computerised prescribing system enhances good practice in prescribing by allowing pre-agreed 'stop dates' to be programmed together with reminders about reviewing treatment and by providing a greater degree of formulary control. It would be valuable for a prospective study to be carried out to establish whether this is the case.

The total antibiotic usage figures for the twelve hospitals varied from 81.33 – 189.37 DDD/100 beddays (mean 114.6). These findings can be compared with data from various European studies which found usage at 37.2 – 42.5,[23] 41 – 51[24] and 25-68. [25] It may be that the much higher rates of antibiotic usage found in this study reflect a difference in the categories of patients that are included in secondary care activity data and how the English health care system operates.

The results do not show an association between a high score in either of the medicines management scores and a low value for the two prescribing indicators of antibiotic usage (Table 2). This lack of relationship leads to a conclusion that enhancing medicines management controls may not reduce antibiotic prescribing. These findings may indicate that antibiotic prescribing patterns within the study hospitals are subject to influences not embraced by the indicators employed. Such factors may include the morbidity of the hospital's catchment population, the casemix of patients treated, which in turn will be governed by the service profile offered by each hospital in terms of specialties and number of beds devoted to each specialty.

A morbidity profile for the catchment population of an individual hospital can be created from analysis of the Primary Care Trust of residence of patients treated and linking this to morbidity measures obtained from census data. This work is on-going. The influence of casemix will influence the WHO measure (DDD/100 beddays) to a greater degree than the DDD/FCE, since variations in casemix e.g. more surgical beds, would decrease the average length of stay within a hospital, whilst conversely a greater proportion of Care of the Elderly beds will generally increase the average length of stay.

The FCE is more closely linked to individual in-patient exposure rates to antibiotics than bedday numbers, as it is a measure of episodes of individual care. However, in some cases the episode of care may involve a number of Consultants that can lead to it being counted as more than one FCE.

It is apparent that additional data is needed before conclusions about the quality of antibiotic usage in a specific hospital can be drawn. The specific profile of antibiotic use by therapeutic group for each hospital, together with local bacterial resistance data, would provide valuable comparative data. This will need to be linked to morbidity data and the usage data linked to activity will require monitoring over a number of years in order to determine the effects of controls systems, be they electronic prescribing systems, utilisation of pharmacists with a remit to change antibiotic prescribing habits or the establishment of multidisciplinary review teams. In order to maximise the opportunity for change to occur pharmacists will need to work closely with microbiologists to influence prescribing habits.

The Medicines Management self-assessment score (MMAS) and the Antibiotic Medicines Management score (AMS) showed a high degree of correlation (r = 0.74), which demonstrates that the MMAS is a valid indicator of antibiotic medicines management arrangements.

Conclusion

The WHO indicator for medicines utilisation, DDD/100 beddays, showed the same level of conformity which was exhibited from the use of the DDD/FCE (r = 0.74) indicating that the DDD/FCE is a useful indicator for identifying hospitals which require further study.

The present study has highlighted the following points:

- It is proposed that both the DDD/100beddays and the DDD/FCE are used to compare antibiotic usage between hospitals in England.
- The electronic prescribing cohort showed the lowest level of usage (DDD/FCE) which may indicate the value of computerised prescribing systems in promoting appropriate antibiotic prescribing.
- Medicines Management measures are only a single contributor to a hospitals antibiotic usage profile and may influence quality but not quantity of antibiotic prescribed.
- Further work over a number of years is required to establish trends to validate these results.

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Table 1. Hospital sites included in the present study

Hospital	Comment	Number of beds	Cohort
1	Urban acute trust	1347	A
2	Urban acute trust	1330	A
3	Urban acute trust	811	A
4	Small town, electronic prescribing	465	B
5	Suburban, electronic prescribing	1279	B
6	County town, electronic prescribing	569	B
7	Urban acute trust	956	C
8	Urban trust	634	C
9	Urban trust (with infectious disease unit)	1320	C
10	Suburban trust	503	D
11	Specialist trust	227	D
12	County town	630	D

Cohort A Medicines Management self assessment score (MMAS) >19

Cohort B Electronic prescribing site

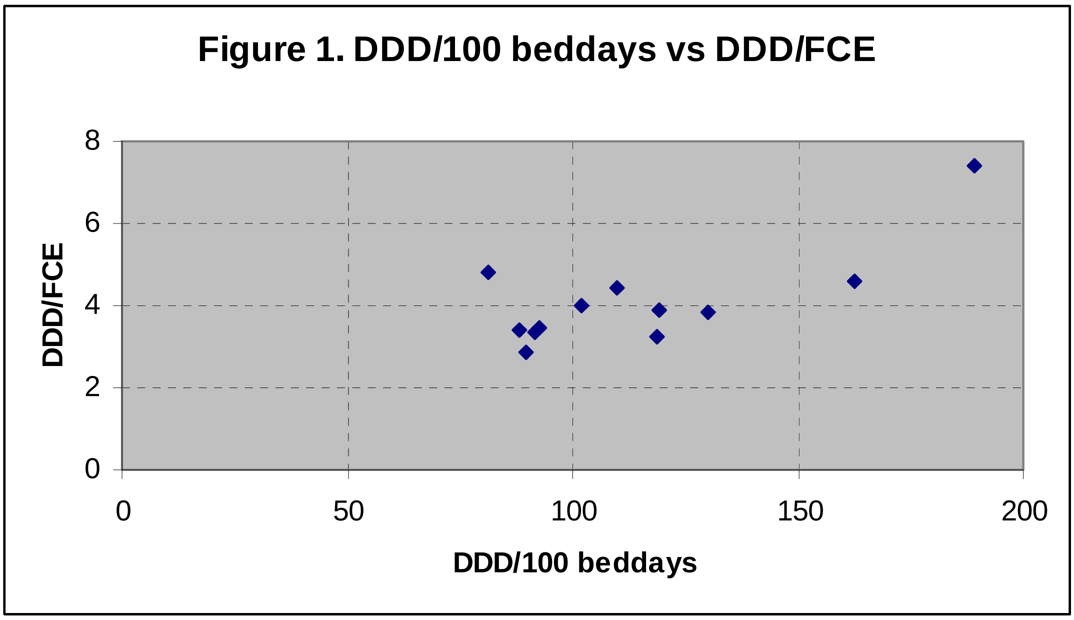
Cohort C Medicines Management self assessment score (MMAS) >15 & <19

Cohort D Medicines management self assessment score (MMAS) <15

Table 2. Summary data 2001/2

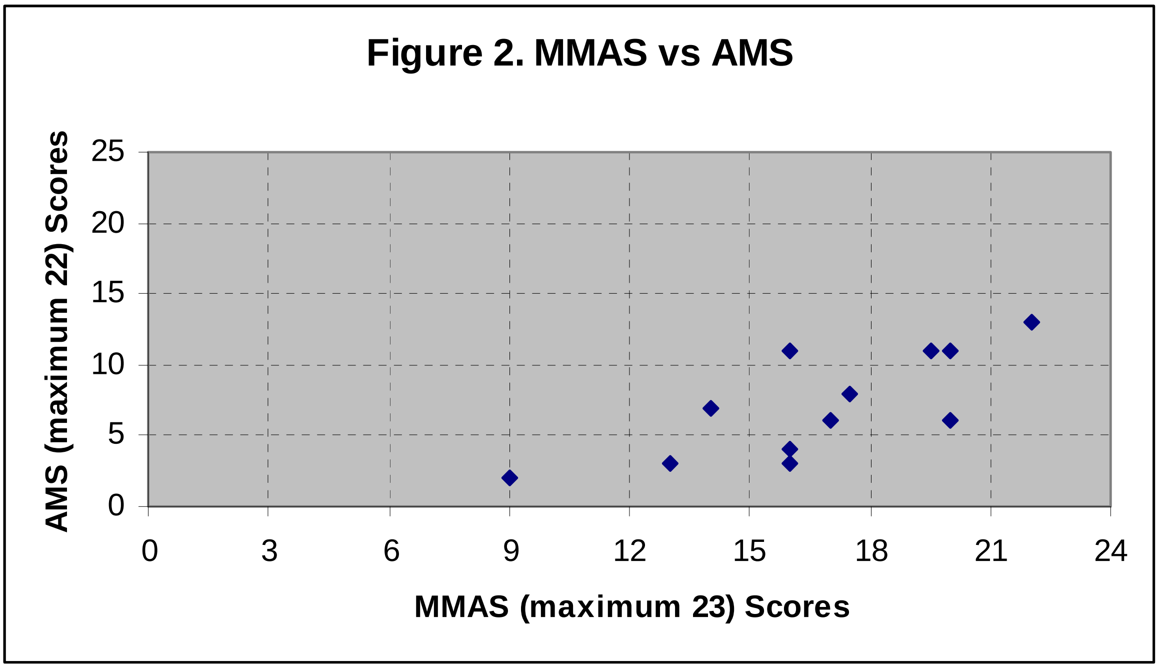
Hospital (cohort)	FCEs	Beddays	DDDs	DDD/ 100beddays	DDD/ FCE	Medicines Management score (max 23)	Antibiotic management score (max 22)
1 (A)	93626	376259	413011	109.76	4.41	20	6
2 (A)	124357	339618	403806	118.9	3.24	20	11
3 (A)	72193	203178	330315	162.57	4.57	19.5	11
4 (B)	48047	142560	185511	130.1	3.86	16	11
5 (B)	97215	373071	328851	88.14	3.38	22	13
6 (B)	45225	166047	152055	91.57	3.35	16	4
7 (C)	66845	263099	268607	102.09	4.01	17.5	8
8 (C)	49856	186924	173368	92.74	3.47	17	6
9 (C)	103607	406430	769661	189.37	7.43	16	3
10 (D)	54963	176542	158421	89.73	2.88	14	7
11 (D)	8984	52906	43032	81.33	4.79	9	2
12 (D)	53192	173265	206543	119.2	3.88	13	3

Figure 1. DDD/100 beddays vs DDD/FCE



Pearson correlation r = 0.74.

Figure 2. MMAS vs AMS



Pearson correlation r = 0.74.