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Economic burden of unjustified medications at hospital discharge

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Summary

Question under study: Medication errors are a major concern for health care since they may cause or lead to inappropriate medication use or patient harm. However, little is known regarding the economic burden of unjustified medications.

Methods: Hospital discharge records of 577 patients were prospectively screened for the presence of unjustified medications. From this sample population, 318 (55%) were eligible and their data were used to assess the monthly costs of unjustified discharge medications, their relationship to the total and each individual's drug expenditure, and the relative cost weights of relevant unjustified drug classes.

Results: The results found that 619 out of 3691 prescriptions (16.8%) were unjustified. The mean (median; 95% CI) monthly costs of unjustified discharge medications were 32 € (27 €; 29 € to 35 €). The percentage of unnecessary treatments was inversely linked to the amount of total individual drug expenditure. For this collective, monthly extra costs due to unjustified medications were 18585 €, and the relative cost weights of the relevant drug classes were 45.8% for gastrointestinal agents (33.8% for proton pump inhibitors), 17.7% for cardiovascular drugs, and 17.2% for psychiatric drugs.

Conclusions: There is a considerable financial burden imposed by unjustified medications at hospital discharge. Discharge medications not motivated by appropriate diagnoses should be questioned. This study should be repeated in other institutions and in a larger population.

Key words: economic burden; hospital discharge; prescription error; unjustified medication

Introduction

Medication errors occur with a frequency of 5.3% and 7.6% in the course of inpatient [1] and outpatient [2] treatment respectively, and about 13% of patients experience an adverse drug event (ADE) within the first month following hospital discharge [3]. The consequences of ADEs range from minor complaints to unnecessary treatment or hospitalization, or even disability or death [4]. Furthermore, ADEs are believed to result in a considerable financial burden to society [5–6].

Medication errors are generated due to either inadequacies in decision making or mistakes in prescription writing, which lead to erroneous, omitted, or unjustified prescription [7]. Few studies have analysed the occurrence of erroneous and omitted discharge medications [8–11], and there are even fewer reports focused on unjustified discharge prescriptions [10–11]. Beyond the question of ADEs, drugs prescribed and consumed without proper indication may cause direct extra costs.

There are, to the authors' knowledge, no studies analysing the expenditure generated by unjustified discharge medications. This study, therefore, prospectively reviewed the hospital discharge information of all patients hospitalised in the Internal Medicine Department, Bellinzona in order to ascertain the number and types of unjustified prescriptions and quantify their possible economic burden.

No conflict of interest.

Methods

Setting and patients

This prospective, observational study from the General Internal Medicine Department of the Ospedale San Giovanni in Bellinzona, Switzerland, was approved by the local Ethics Committee. The presented data are a subgroup analysis of a recently published study [11]. The current study considered and analysed the hospital discharge records of all patients hospitalised between December 1, 2005 and February 28, 2006.

Data collection, definition and calculations

During the first two weeks of the project, two experienced, board registered internists independently examined the same 40 discharge summaries (DS) by means of a structured form. Evaluation of each DS was consecutively carried out, once it had been signed by the involved physicians and sent to the general practitioner. Reliability across reviewers was subsequently assessed by a third physician. In order to further improve the consistency of the data, the remaining evaluation (ten weeks) was performed jointly by two internists. The time-window for data collection was determined by the protocol of the main study [11]. The study assessed general patient information and relevant diagnoses (such as, requiring a therapy during or after hospitalisation, or requiring a change in medication) on the whole study group. For the cost analysis of unjustified medications the investigation focused on the subgroup of patients concerned.

An "unjustified medication" was defined as proposed by Dean [7]: a medication inconsistent with the corresponding diagnoses (prescribing a drug for which there is no indication for that patient). Other determinants (such as, inappropriate choice of a drug, exceeding duration of treatment), theoretically subsumed as unjustified, were disregarded for the study (for example, inappropriate antibiotic according to the regional bacterial resistance patterns). Assessment of the presence of unjustified medications was based on textbooks [12–13] or online literature [14]. Unjustified medications requiring further evaluation by the general practitioner (corresponding suggestion in the text or in the prescription list) were excluded from the analysis. For the calculation of drug expenditure, the current investigation relied on the official price list given by the Swiss drug compendium, assuming prescription and acquisition of appropriate packages were required for a one-month treatment [15]. The costs induced by the prescription of antibiotics were based on the indicated duration or, if duration was not indicated, on a single acquisition of the smallest original package, since antibiotics are usually used for short duration treatments. All costs were converted from Swiss francs to € (1 € = 1.55699 CHF; exchange rate: January 1st 2006).

Statistical analysis

All of the analyses were performed with S-Plus 7.0 for Windows, Enterprise Developer. If not specified, p-values are given for Student's t-test of comparisons of two groups. Confidence intervals (CI) for frequencies are based on binomial distributions. The p-values considered were always derived from two sided tests. The relationship between the total monthly expenditure per patient and the corresponding costs of unjustified medication was investigated with local regression (locally weighted scatterplot smoothing). For the cost estimate at a national level, CIs were obtained from Monte Carlo simulations: 1000 samples of n = 178300 patients with single hospitalisation recovered yearly in the Departments of Internal Medicine in Switzerland. For every patient a binomial random value of parameter p was generated (p itself generated from a normal distribution with a mean estimated from the study sample); if the value was one (at least one unjustified medication), then a cost was chosen at random among the observed ones.

Results

In 318 of 577 reviewed discharge summaries, at least one unjustified medication was found. General patient characteristics of all patients versus those affected by unjustified medication are compared in table 1. Cardiovascular disorders were the most prevalent discharge diagnoses. Reliability across reviewers for the classification of unjustified medications was considered good (χ = 0.85).

From 3691 prescriptions, 619 (16.5%) were unjustified (1.1 ± 1.3 per patient; range 0 to 7). Unjustified medication affected 50% of the men and 61% of the women (p = .01), and increased significantly (p <.001) along with the number of prescribed drugs. The surplus of unjustified medications in women (mean number of drugs in women versus men) was basically caused by anti osteoporosis agents (0.29 vs 0.05; p <.001), gastrointestinal agents (other than proton pump inhibitors [PPIs]) (0.41 vs 0.21; p <.001) and antideppres-

Table 1

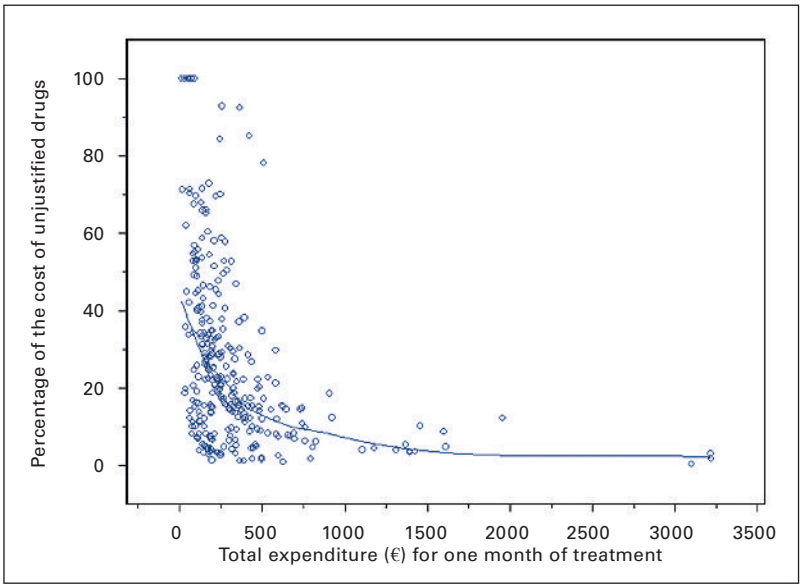
Characteristics of the whole study sample (ALL) and the collective concerned with unjustified medications (UM). Mean values are given ± standard deviation. The last column displayed the p-values resulting from a comparison with the two groups of patient: with and without unjustified medication.

Characteristics	All (n = 577)			UM (n = 318)			Comparison
	Men (n = 326)	Women (n = 251)	p-value	Men (n = 164)	Women (n = 154)	p-value	p-value
Age, years	64.1 ± 16.6	69.1 ± 17.3	<.001	69.2 ± 14.7	72.7 ± 14.5	.04	<.001
Length of hospital stay, days	8.5 ± 9.6	8.6 ± 6.9	.93	10.7 ± 10.9	9.7 ± 7.2	.35	<.001
Diagnoses, n	4.6 ± 2.4	4.7 ± 2.3	.52	5.3 ± 2.4	5.3 ± 2.2	.96	<.001
Diagnoses with medications, n	3.6 ± 2.1	3.9 ± 2.0	.23	4.3 ± 2.1	4.3 ± 1.9	.80	<.001
Total medications, n	6.1 ± 3.5	6.8 ± 4.2	.02	7.8 ± 3.1	8.4 ± 4.0	.11	<.001
Unjustified medications, n	1.0 ± 1.3	1.2 ± 1.4	.01	1.9 ± 1.1	2.0 ± 1.2	.31	–

sants (0.31 vs 0.18; p = .02). About 45% (279 of 619) of unjustified prescriptions (PPIs in 68 cases, benzodiazepines in 46 cases and other gastroenterological agents in 21 cases) was already present at admission.

Figure 1

Percentage of the costs of unjustified drugs as a function of the individual total drug expenditure (n = 318). The fitting curve was obtained with a loess local regression model.



The analysis of the subgroup, affected by unjustified prescriptions, revealed 360 € (237; 311 to 408) mean monthly costs (median; 95% CI) for all discharge medications, and 58 € (49; 53 to 64) accounted for unjustified medications. No sex-dependent differences were found regarding overall and unjustified costs. Unjustified medication was on average 16.2% (14.0% to 18.8%) of the drug expenditure. The individual amount – that is the mean of the means – stands in average for 25.5% (18.6; 23.0 to 27.9) of the individual drug expenditure. This apparent discrepancy can be explained by the non linear relationship between total drug expenditure and unjustified drug expenditure. A non linear decreasing distribution was observed between total drug expenditure and costs of unjustified medications, as illustrated in figure 1: the lower the amount, the higher the percentage of unnecessary treatments.

The costs of all discharge medications for this subgroup were 114 516 € per month, and unjustified costs accounted for 18 585 €. The financial burden of one month of treatment of the medications according to their justification and drug classes is illustrated in table 2. Unnecessary gastroenterological drugs (45.7%; 33.8% PPIs), cardiovascular drugs (17.7%), and psychiatric drugs (17.2%) accounted for about 80% of the overall

Table 2

Monthly costs of discharge medications from 318 patients according to drug classes and justification of medication. Data are expressed in €.

Drug classes	Medication	Unjust. Med.[1]	Portion of Tot. Unjust. Med.	Patients concerned
	€	€ (%)	(%)	n (%; 95%CI)
Cardiovasculars	35 412	3292 (9.3%)	17.7	284 (49.2%; 45.1–53.4)
– Nadroparine	12 490	1013 (8.1%)	5.4	37 (6.4%; 4.5–8.5)
– Statins	6073	1098 (18.1%)	5.9	114 (19.8%; 16.6–23.1)
– Diuretics	3738	125 (3.4%)	0.7	116 (20.1%; 16.8–23.4)
– ACE[2]	3191	110 (3.5%)	0.6	117 (20.3%; 17.0–23.6)
– Clopidogrel	3092	129 (4.2%)	0.7	48 (8.3%; 6.1–10.6))
– Betablockers	1673	110 (6.5%)	0.6	128 (22.2%; 18.9–25.6)
– Calcium antagonist	1023	131 (12.8%)	0.7	39 (6.8%; 4.9–8.8)
– others[3]	4130	575 (13.5%)	3.1	228 (39.5%; 35.5–43.5)
Renal drugs	28 085	52 (0.2%)	0.3	24 (4.2%; 2.6–5.9))
– Erythropoietin	26 186	0 (0)	0	18 (3.1%; 1.7–4.7%)
Gastroenterologics	12 876	8506 (66.1%)	45.7	205 (35.5%; 31.7–39.5)
– PPI[4]	8841	6273 (71%)	33.8	175 (30.3%; 26.7–34.1)
– others[5]	4035	2233 (55.3%)	12.0	78 (13.55%; 10.7–16.3)
Psychiatrics	8360	3190 (38.2%)	17.1	196 (34.0%; 30.2–37.8)
– Neuroleptics	2828	1245 (44.0%)	6.7	37 (6.4%; 4.5–8.5)
– Benzodiazepines	2747	902 (32.8%)	4.9	156 (27.0%; 23.4–30.7)
– Antidepressants	2785	1043 (37.5%)	5.6	65 (11.3%; 8.8–13.9)
Pneumologics	4768	422 (8.8%)	2.3	55 (9.5%; 7.3–12.0)
Antibiotics	3927	366 (9.3%)	2.0	92 (15.9%; 13.0–19.1)
Antidiabetics	3063	69 (2.3%)	0.4	61 (10.6%; 8.1–13.2)
Neurologics	2967	130 (4.4%)	0.7	43 (7.5%; 5.4–9.7)
Others[6]	15 058	2557 (17.0%)	13.8	231 (40.0%; 36.0–44.0)
Total (95%CI)	114 516	18 585 (16.2%)	100.0	318 (56.8%; 52.9–60.8)

[1] Unjustified medication expressed in € (% of the total expenditure for this class of medication); [2] ACE, angiotensin converting enzyme inhibitor; [3] Anticoagulants, nitroglycerin, calcium antagonists; [4] PPI – proton pump inhibitor; [5] Laxatives, probiotics, antimotility drugs; [6] Drugs <2.5% total expenditures.

costs of unjustified drugs. The proportions of unjustified medications in different drug classes are shown in figure 2. Prescriptions were considered unjustified for PPIs in 71%, other gastroenterological drugs in 55%, vitamins in 48.3%, and agents for urologic diseases in 44.3%.

Discussion

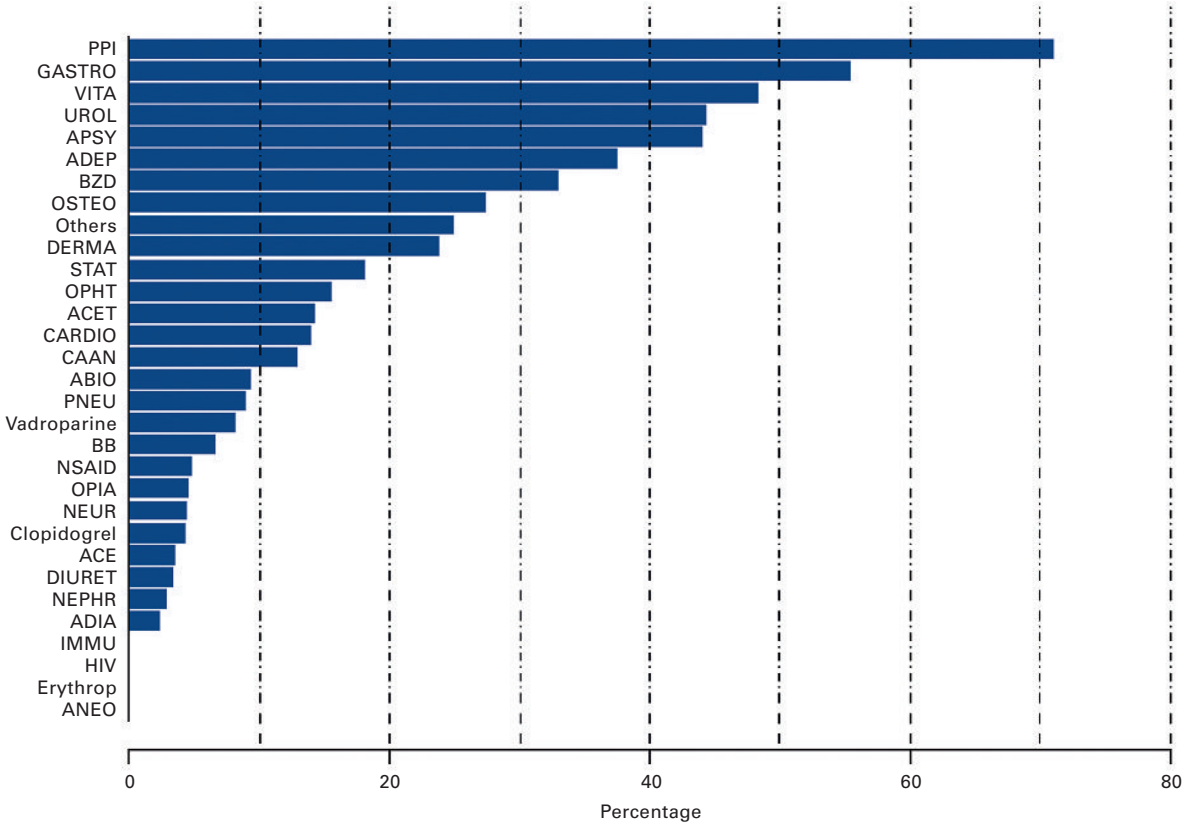
This prospective study was performed in order to quantify the additional costs generated by unjustified discharge medications. The findings demonstrated that more than half of all patients were prescribed at least one drug without an appropriate indication, and that the resulting induced monthly extra costs might reach 32 € per patient.

Every sixth discharge medication was judged to be unnecessary. The drugs most often prescribed without proper justification were PPIs, other gastroenterological agents (antacids, promotility agents, laxatives, and probiotics), vitamins, medications for urological diseases (urinary incontinence, benign prostatic hyperplasia), and neuroleptics. Interestingly, the first two drug classes also presented the highest relative cost weights. Inappropriate prescription of PPIs has previously been reported [16–18], and in the current study the prescription of these medications was based neither on a clear indication, a proper diagnosis [19–21] nor on a proxy indication (review of the hospital discharge information for possible indications discernible by context). The fact that more than half of unjustified medications were present just at hospital discharge might reflect a slightly higher prescribing attitude by hospital physicians as compared to general practitioners.

In the subgroup, extra costs induced by unjustified discharge medications were substantial. Accordingly, the nationwide economic impact of this practice might be enormous, when considering that in OECD nations more than 10% of the total expenditure on health is usually spent on pharmacologic treatment [22]. An extrapolation of the annual extra costs of the subgroup to the entire Swiss population (same percentage [55% of patients] and distribution of unjustified medications for 178300 patients with a single hospitalisation [approximately 56% of 314779 hospitalisations] in departments of Internal Medicine during one year [23]) would result in supplementary costs of approximately 67.7 million € (95%CI

Figure 2

Percentage of the unnecessary drugs taken from the total monthly expenditures, per class of medications. The abbreviations stand for: ABIO, antibiotics; ACE, angiotensin converting enzyme inhibitor; STAT, statins; ADEP, antidepressants; ADIA, antidiabetics; NSAID, non steroidal anti inflammatory drugs; Others, other drugs; ACET, acetaminophen; IMMU, immunsuppressive agents; BB, beta-blockers; BZD, benzodiazepines; CAAN, calcium antagonists; CARD, other cardiologic drugs; DERMA, dermatologicals; DIURET, diuretics; GASTRO, other gastrointestinal agents; HIV, HIV (anti) agents; NEPHR, renal failure (agents); APSY, anti psychotics; NEUR, neurologic disease agents; OPHT, ophthalmic preparations; ANEO, antineoplastic agents; OPIA, opiates; OSTEO, anti osteoporosis agents; PNEU, pneumologics; PPI: proton pump inhibitors; UROL, urologics; VITA, vitamins.



67.2–68.2). This approximation might largely underestimate the reality when the following are considered: a) the essentially undefined duration for which medications were prescribed; b) the repeat admissions were not considered; c) unjustified prescriptions are presumably not limited to patients discharged from departments of Internal Medicine; and d) the findings may also be applied to outpatient prescribing practices. Just adding the annual 322 000 patients with single admissions to Swiss Departments of Surgery would theoretically more than double the previously mentioned amount. In contrast, this approach might possibly have resulted in a overestimation of extra costs as about 50% of the unjustified prescriptions are also sold at smaller packages than required for an one-month treatment, and because an unjustified prescription does not automatically signify unnecessary medication.

Strategies designed to eliminate prescriptions of unjustified drugs should focus on the causes demonstrated in the current study. Inappropriate decision-making (for example failure to remove temporarily prescribed PPIs from the prescription list) and inadequate documentation of the DS (lack of an unambiguous relationship between diagnoses and medications) may have played key roles. As these two types of errors may be reasonably interdependent, a variety of corrective actions should be implemented rather than just one punctual improvement [11]. Furthermore, physicians should be encouraged to stop apparently questionable medications, as patients, if adequately informed, generally welcome the withdrawal of long-term drug treatment [24]. Thus, general practitioners receiving a hospital discharge summary should be wary of giving full credit to its content and critically question medications not motivated by appropriate diagnoses. A patient-centered discharge interview aiming at improving the patients' knowledge about their medications [25] might theoretically also help to uncover unjustified therapy. Irrespective of other improved outcomes, the use of clinical pharmacists in the inpatient setting has also proven efficacious in reducing medications [26]. Finally, failure to reconcile the medication history with discharge orders has resulted in increased medication errors, emphasising the logic to urgently implement this technique [26–27].

The current study exhibits some potential limitations. Firstly, this is a pilot project performed on DS, in a unique centre (and with a small population) and by a limited number of reviewers. Some inherent bias might therefore exist, since: a) the contents of discharge summaries will never entirely coincide with reality and even the in-depth analysis of the corresponding charts will always be helpful; and b), all investigators were trained together and were working at the same institution. Moreover, prescription practices might vary among hospitals and regions according to the implemented quality control systems and to the patient populations. Thus, the generalisation of the results has to be confirmed. A second limitation concerns the definition applied and the method of data collection. Although the definition proposed by Dean et al. [7] seems credible and useful, it has not yet been validated by similar studies. Furthermore, even though the entire discharge records were meticulously reviewed, it is not known whether the presented data are entirely correct, as the justification for inappropriate medications might theoretically have been documented in other records (e.g., hospital medical charts). In addition, the medication lists of the DS were not crosschecked with the prescription orders directly consigned to the patients. However, this latter form suitably prearranged with relevant data from the discharge summary, was most likely not modified later on. On the whole, an unambiguous relationship between diagnoses and medications might not only prevent the prescription of unjustified medications but also avoid a lack in documentation of diagnoses, the latter being a major criteria defining the degree of reimbursement for hospitalisations (diagnosis related groups). Thirdly, the current study was not designed to connect the documented unjustified medications to clinical outcomes, explicitly adverse drug events, or additional hospitalisations. These possible negative outcomes would have further increased the financial burden. Finally, the estimates regarding the whole population of Switzerland assume similar distributions of sex, age, and pathologies to the ones observed in Bellinzona. This hypothesis is highly imprecise and would need better stratification. Other than the economic impact of unjustified medications, their ethical implications should also be considered, as excess charges for the health system implicitly curtail resources for other important sectors.

In conclusion, this study emphasises that there is a considerable financial burden imposed by unjustified hospital discharge medications. Corrective measures are deemed imperative. In order to confirm the current data, this study should be repeated in other institutions and on a larger population.

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References

1 Bates DW, Boyle DL, Vander Vliet MB, Schneider J, Leape L. Relationship between medication errors and adverse drug events. J Gen Intern Med. 1995;10:199–205.
2 Gandhi TK, Weingart SN, Seger AC, Borus J, Burdick E, Poon EG, et al. Outpatient prescribing errors and the impact of computerized prescribing. J Gen Intern Med. 2005;20:837–41.
3 Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW. The incidence and severity of adverse events affecting patients after discharge from the hospital. Ann Intern Med. 2003;138:161–7.
4 Kelly WN. Potential risks and prevention, Part 1–4: Fatal adverse drug events, drug induced permanent disabilities, drug induced threats to life and reports on significant drug events. Am J Health Syst Pharm. 2001;58:1317–412.
5 Bates DW, Spell N, Cullen DJ, Burdick E, Laird N, Petersen LA, et al. The costs of adverse drug events in hospitalized patients. Adverse Drug Events Prevention Study Group. JAMA. 1997;277:307–11.
6 Lepori V, Perren A, Marone C. Unerwünschte internmedizinische Arzneimittelwirkungen bei Spitaleintritt. Schweiz Med Wochenschr. 1999;129:915–22.
7 Dean B, Barber N, Schachter M. What is a prescribing error? Quality in Health Care 2000; 9:232–7.
8 van Walraven C, Weinberg AL. Quality assessment of a discharge summary system. CMAJ. 1995;152:1437–42.
9 Wilson S, Ruscoe W, Chapman M, Miller R. General practitioner-hospital communications: a review of discharge summaries. J Qual Clin Pract. 2001;21:104–8.
10 Adhiyaman V, Oke A, White AD, Shah IU. Diagnoses in discharge communications: how far are they reliable? Int J Clin Pract. 2000;54:457–8.
11 Perren A, Previsdomini M, Cerutti B, Soldini D, Donghi D, Marone C. Omitted and unjustified medications in the discharge summary. Qual Saf Health Care. 2008;17:in press.
12 Rakel RE, Bope ET. Conn's Current Therapy 2006. Philadelphia: Saunders Elsevier; 2006.
13 Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL. Harrison's Principles of Internal Medicine 16th edition. New York, Chicago, San Francisco: McGraw-Hill Medical Publishing Division; 2005.
14 ©2006 UpToDate® in Internal Medicine and Subspecialities, online edition 14.2, available from: www.uptodate.com
15 Arzneimittelkompendium der Schweiz 2006; 27th ed. Basel (Switzerland), Documed AG; 2006.
16 Zink DA, Pohlman M, Barnes M, Cannon ME. Long-term use of acid suppression started inappropriately during hospitalisation. Aliment Pharmacol Ther. 2005;21:1203–9.
17 Parente F, Cucino C, Gallus S, Bargiggia S, Greco S, Pastore L, et al. Hospital use of acid-suppressive medications and its fallout on prescribing in general practice: a 1-month survey. Aliment Pharmacol Ther. 2003;17:1503–6.
18 Hajjar ER, Hanlon JT, Sloane RJ, Lindblad CI, Pieper CF, Ruby CM, et al. Unnecessary drug use in frail older people at hospital discharge. J Am Geriatr Soc. 2005;53:1518–23.
19 Cook DJ, Fuller HD, Guyatt GH, Marshall JC, Leasa D, Hall R, et al. Risk factors for gastrointestinal bleeding in critically ill patients. N Engl J Med. 1994;330:377–81.
20 Lanza FL. A guideline for the treatment and prevention of NSAID-induced ulcers. Members of the Ad Hoc Committee on Practice Parameters of the American College of Gastroenterology. Am J Gastroenterol. 1998;93:2037–46.
21 Chiba N, De Gara CJ, Wilkinson JM, Hunt RH. Speed of healing and symptom relief in grade II to IV gastroesophageal reflux disease: a meta-analysis. Gastroenterology. 1997;112: 1798–810.
22 OECD Health Data 2008: Statistics and Indicators for 30 Countries. http://www.oecd.org/document/30/0,3343,en_2649_34631_12968734_1_1_1_37407,00.html
23 Office fédéral de la statistique. Statistique médicale des hôpitaux 2006 – Tableaux standard, Neuchâtel-Switzerland. http://www.bfs.admin.ch/bfs/portal/de/index/news/publikationen.Document.104493.pdf
24 Straand J, Sandvik H. Stopping long-term drug therapy in general practice. How well do physicians and patients agree? Fam Pract. 2001;18:597–601.
25 Micheli P, Kossovsky MP, Gerstel E, Louis-Simonet M, Sigaud P, Perneger TV, et al. Patients' knowledge of drug treatments after hospitalisation: the key role of information. Swiss Med Weekly. 2007;137:614–20.
26 Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical Pharmacists and Inpatient Medicale Care: a systematic review. Arch Intern Med. 2006;166:955–64.
27 Pippins JR, Ghandi TK, Hamann C, Ndumele CD, Labonville SA, Diedrichsen EK, et al. Classifying and predicting errors of inpatient medication reconciliation. J Gen Intern Med. 2008; 23:1414–22.