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Influence of hospitalisation on the prescription of drugs in the primary care sector

- Master Thesis -

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1 INTRODUCTION

1.1 Drug expenditures in the primary care sector in Germany

The costs for drugs prescribed by the office based physicians at the expense of the statutory health insurance (SHI) in Germany raised within the first 9 months of the year 2005 by 19.1 % compared to the same period in the previous year and will add up to 600 billion € for the entire year (Bundesministerium für Gesundheit und Soziale Sicherung 2005). Drugs now account for 17.6% of the overall expenditures of the SHI and are therefore the second biggest share after that for hospitals. Expenses for pharmaceuticals exceed therewith those for fees for the office based physicians by about 2.5 billion € only within the first 9 months of 2005 (Bundesministerium für Gesundheit 2006, Schröder 2005). Several attempts concerning the legislation have been made to reduce the costs for drug therapy or at least to lower the increase, starting with the first Health Insurance Cost-Containment Act back in 1977. During the last years nearly annually new regulations were implemented and the current development of costs again led to a parliamentary bill for a new act (Arzneimittelversorgungs Wirtschaftlichkeitsgesetz, Economic Optimisation of Pharmaceutical Care Act, Deutscher Bundestag 2006).

There are three basic principles leading to an increase in pharmaceutical expenditures: a rise in drug utilisation, higher sales prices for identical finished drugs or a change in the structure of prescribed drugs towards those with higher prices. The attempts made in the history act on all of these factors. An increase in the number of prescriptions should be prevented by the exclusion of pharmaceuticals of doubtful efficacy or over the counter medicine that are not reimbursable anymore, and the implementation of co-payments for patients for consultations of office-based physicians (Bundesgesetzblatt 2003). Measures to avoid rises in the prices of drugs - at least on the expense of the SHI - are manufacturers' discount, changes in the drug price ordinance to reduce the costs for the distribution of drugs or a rise in the co-payment for the insured. Moreover reference prices have been introduced for drugs

containing certain substances, which determine ceilings paid by the SHI for these drugs.

However, the number of prescriptions decreased nearly every year since 1995 with a sharp reduction in 2004, and the prices for identical finished drugs remained nearly unchanged within the last decade (Nink and Schröder 2005, Bundesministerium für Gesundheit 2005). The most relevant point with regard to the increase in pharmaceutical expenditures is therefore a change in the structure towards the prescription of more expensive drugs. These are mostly novel, on-patent drugs. Some of these have new mechanism of action and are indicated for severe and / or seldom illnesses. Some of them are moreover complicated to produce like specific antibodies or enzyme inhibitors used in anticancer therapy. These innovations are often mentioned to justify high sales prices of new drugs. However, on the one hand it can be doubt that the investment into research is as high as pronounced by the manufactures, and several drugs that account for some major profits are developed by universities, so at the expense of the public (Angell 2004). More important is however, that many of the new and economic relevant drugs are similar to substances already on the market for the same indications. From the 33 new compounds that came onto market in Germany in the year 2004, 18 were classified as innovations or substances with improved action (Fricke and Schwabe, 2005). However from those 10 with the highest number of prescriptions within the first year after being launched, 9 possess no or only marginal differences to drugs being already on market. A current study performed in Canada shows that eighty per cent of the recent expenditures growth is attributable to new drugs launched in established chemical subclasses (Morgan et al. 2005). For the manufacturers these often called Me-Too-drugs provide therefore an opportunity to offer a product on a therapeutic area where great profits are possible (Goozner 2004). On the contrary, for the health care purchaser - and therefore at the end the patients - these pharmaceuticals yield to an economic burden, at least if comparable alternatives are off-patent and less pricey generics are available.

1.1.1 Two blockbuster: Atorvastatin and pantoprazole

Two examples of substances often classified as Me-Too-drugs are atorvastatin and pantoprazole. Atorvastatin is a member of the HMG CoA reductase inhibitors (statins), that are used for lowering blood levels of cholesterol and fats, and help to prevent heart disease, strokes, and heart attacks. According to a recent published review of the Institut für Qualität und Wirtschaftlichkeit im Gesundheitswesen (Institute for Quality and Economic Efficiency in Health Care, IQWiG) there is no decisive advantage for atorvastatin in comparison with other statins (Institut für Qualität und Wirtschaftlichkeit im Gesundheitswesen 2006). According to this the effectivity of simvastatin is even better verified for important indications, and this result is in line with several others (AMB 2005, at 2000). Nevertheless atorvastatin was by far the most sold drug throughout this decade until 2004. Because for simvastatin generics with striking lesser prices are available since 2003, there have been potential savings only for atorvastatin of about 300 million € for the SHI in Germany in 2004 (Klose and Schwabe 2005). Since the manufacturer of atorvastatin refuses to reduce the prices of the substance on the level of a reference price newly introduced at the beginning of 2005, there are out-of-pocket payments of up to 60€ per package of this substance. As a consequence the number of prescriptions decreased dramatically and atorvastatin did not play that major role in drug therapy in 2005 in Germany anymore. Thus, the refusal of reducing the selling prices led to the most drastic example showing an influence of legislation measures on the prescription of drugs in the ambulatory sector.

Now pantoprazole is the compound of the most sold finished drug in the federal state of Germany this analysis was conducted, and the second most nationwide with marked increases during the last years (Spitzenverbände der gesetzlichen Krankenkassen 2006). It belongs to the proton-pump inhibitors (PPIs), which act by decreasing the amount of acid made in the stomach and are used in the treatment of gastric ulcer and gastroesophageal reflux disease. In general the differences in effectiveness or side effects of the different PPIs are presumed to be marginal (McDonagh and Carson 2005; Bundesausschuss für Ärzte und Krankenkassen 2003). Due to the availability of generic alternatives for omeprazole, which is a

comparable agent to pantoprazole, the potential savings for a replacement of pantoprazole alone were about 95.5 million € for the SHI in Germany in the year 2004 (Mössner 2005).

1.2 Influencing factors on drug prescriptions in secondary care

In Germany as in other countries health care is provided in a primary care sector by office based physicians and a secondary care sector in the hospitals. Thus far we described only the situation of drug provision in the primary care sector that differs with respect to the legal background considerably from that in the hospitals. In the ambulatory sector accounting concerning prescribed drugs occur directly between the SHI and the data processing centre for pharmacies. Drugs prescribed by office based physicians can be attributed to the single prescriber, but are usually not a part of their budget, and only in rare cases of proven uneconomical prescription behaviour this will have a direct consequence for him. On the contrary health care provision in the hospital comprises the supply of drugs as well and referring to this, the expenditures for drugs are a part of the overall hospital-budget. In return the strict legal regulations as defined in the Social Law, the Decree on Drug Margins, (Arzneimittelrichtlinie) or the Drug Price Ordinance (Arzneimittelpreiverordnung) do not count for the hospitals.

These differences lead to other economic incentives concerning a choice of drugs within a hospital compared to the ambulatory sector - even if at the end both are paid by the SHI (Sachverständigenrat zur Begutachtung der Entwicklung im Gesundheitswesen 2005). In general the hospitals use drug formularies based on recommendations of their own drug committee, and about the listed drugs price negotiations take place with the manufacturer of these drugs. Here manufacturer warrant special conditions for new or expensive drugs for the short period of inward therapy or the hospitals even get free specimen. A hospital-initiated therapy continued in the ambulatory sector is then prescribed at the expense of the SHI. Manufacturers may therefore use the hospitals to establish new on-patent drugs on the market.

Since hospitals are moreover paid per case, and not per days of treatment as at the beginning of this decade, an early discharge is advantageous for them. This led to a decrease of the average length of stay during the last years and more drugs used only transitional and until the last years nearly only within the hospitals, play a more important role in the primary care sector. Moreover a medication is nowadays more cost efficient for the hospital when it makes an early discharge possible or decrease the risk of a longer stay.

The differences between the two sectors were shown to be obvious with regard to the cost consciousness of the attending physicians as well: in a Dutch study performed some 10 years ago about a quarter of general practitioners (GPs) did not think that economic considerations should be taken into account when making prescribing decisions, while among hospital physicians this rate appeared to be twice as high (Denig and Haaijer-Ruskamp 1995). Even if the cost consciousness will be higher nowadays in Germany in both sectors, these differences may be still a relevant factor.

1.3 Changes of drug prescription at the interface between primary and secondary care sector

1.3.1 Extent of changes in drug therapy

Changes of the medication due to hospitalisation is an often described phenomenon, and can occur both after admission of the patient in the hospital and after discharge by the office based physicians.

About three quarters of German GPs report that drugs were added or changed during hospitalisation (Himmel et al. 1996a). Detailed data are collected mainly for selected populations or patients from specific wards or disease pattern. Especially for elderly it was shown that hospitalisation is associated with modifications in nearly half of all drugs prescribed before admission (Beers et al. 1989, Sheehan et al. 1996). This is in accordance with a study on drugs used in chronic treatment with patients referred to internal medicine wards, where again about half of the drugs prescribed by GPs

were continued during hospitalisation, while the others were cancelled or changed (Himmel et al. 2004).

On the other hand there is a change of the recommended discharge medication in the ambulatory care sector. Due to a study of Adl et al. this occur in as many as 2/3 of the patients with the most frequent changes due to additional prescribing of drug groups (Adl et al. 2001). Others report changes of up to 50% of all prescriptions (Harder 2005, Himmel et al. 1996b, Stuffken and Egberts 2004). However minor changes like that of the manufacturer are counted here as well, and for essential indications like cardiovascular disease and diabetes, GPs followed widely the discharge recommendations (Harder 2005).

Taken together, according to the available evidence drug changes affect about half of all drugs prescribed either at admission or after discharge.

1.3.2 Reasons for changes in drug therapy

There are different reasons for the described changes. First of all a change in the hospital will often occur for medical reasons being responsible for the admission like a worsening of the health situation of a patient with a chronic disease or an acute event like a heart attack or a stroke. Beers argue that cancelling of GPs drugs in the hospital demonstrates the often unnecessary and ineffective use of drugs by the GPs and that replacement of drugs indicates the availability of better alternatives (Beers et al. 1989). In another study the most common reason for stopping a drug was that the hospital physician could find no indication for its use (Sheehan et al., 1996).

On the other hand there is also a high rate in changes concerning drugs that are not associated with the reason of the hospital stay. This indicates that other factors than only medical considerations are important (Himmel et al 2004). Rather the different incentive systems for hospitals as described above are probably of relevance. So hospitals exhibited specific drug profiles that lead to a total replacement of some generics by brand name drugs or exclusive administration of a certain preparation regardless of the GPs prescription (Himmel et al. 1996b). This pattern of changes indicate an influence of the use of drug formularies within the hospital, and therefore

non-availability of drugs in the hospital formulary is a major non-pharmacological reason the for drug changes after admission (Harder et al. 1991). These drug formularies lead moreover to a change in medication in the way that an approved medication of chronic patients is changed to use a more modern pretended state of the art medicine (Sachverständigenrat zur Begutachtung der Entwicklung im Gesundheitswesen 2005).

Possible influencing factors for a change of the discharge medication in the ambulatory sector include therefore preceding changes in the prescription during hospitalisation, which are not attributable to a conscious clinical decision. As a consequence the continuation of drugs taken before hospital admission might occur (Cochrane et al. 1991, Adl et al. 2001). Moreover, even if there are good reasons for a change in drug therapy, the office-based physician might not get knowledge about it. Due to a substantial deficiency in the communication between hospitals and GPs, the latter receive detailed information about drug changes in only less than 5% (Himmel et al. 1996b, Roth-Isigkeit and Harder 2005). This communication is even more important, because the lack of patients' knowledge about their own medication is described as well as precarious (Harder et al. 2005).

Another often neglected problem concerning drug therapy at the interface of primary and secondary care is the occurrence of medication errors, which again is related to a lack in communication. So a Swedish study on elderly patients with an average use of more than 10 drugs before, during and after hospital stay, revealed two medication errors each time a patient was transferred between primary and secondary care (Midlov et al. 2005). In another study with patients with at least 4 drugs at discharge in 32% of the patients a drug was incorrectly added or deleted, and 18% of the patients were taking the correct drugs but had errors in dosing (Omori et al. 1991).

Changes of the discharge recommendations may also occur as a result of the cost pressure in the ambulatory sector. Most authors agree that the drugs initiated by the hospitals or at specialised care are indeed more expensive than those initiated by the GPs (Feely et al. 1999, Hakansson et al. 2001). Nevertheless, economic considerations were find to be of minor relevance for changes of the discharge medication (Adl et al. 2001, Hach et al. 2005).

1.4 Aim of the presented analysis

Our analysis is based on outpatient prescription data of patients that were hospitalised and compares the prescribed drugs before admission and after discharge. In contrast, most other studies collect data mainly by questionnaires. Therefore one aim is to evaluate if an analysis based on drug prescriptions from the primary care sector only is suitable to describe an effect of hospitalisation on drug therapy.

There are three points of special interest:

1. Total changes in drug prescription patterns of an unselected population after a hospital stay under consideration of economic effects

2. Changes that occur at an individual level

3. The effect of hospitalisation on the prescription of the two most sold drugs, atorvastatin and pantoprazole, as examples of economic relevant on-patent drugs with generic alternatives

2 ARTICLE

The article is prepared for submission to the European Journal of Clinical Pharmacology.

Instructions to authors are available at:

http://www.springer.com/sgw/cda/pageitems/document/cda_downloaddocument/0,11855,0-0-45-73510-p1030651,00.pdf

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Abstract

Objective: To explore the influence of hospitalisation on the prescription of drugs in the primary care sector, particularly on HMG CoA reductase inhibitors (statins) and proton pump inhibitors (PPIs).

Methods: Analysis of outpatient drug prescriptions of members of a statutory health insurance that were inpatient in the I. quarter 2004. Prescriptions done within three months before admission or after discharge were analysed. Drugs were coded with central pharmaceutical number, active substances and costs were linked with the ATC-Code and the pharmacy price schedule, respectively.

Results: 2,426 patients received drugs before and after hospitalisation. After discharge the mean number of prescription per patient remained unchanged, while the number of different active substances decreased (-4%). Still overall costs increased after discharge due to higher costs per prescription (+17%). Changes in medication affected nearly every patient, and more than 50% of all substances prescribed to an individual before admission or after discharge were cancelled or newly started, respectively. In both therapeutic subgroups analysed in detail, PPIs and statins, significant increases in the number of patients under therapy occurred (+27% and +16%, respectively). The increase in PPI-medication was due to a 58% rise in the number of patients getting pantoprazole, while that for statins comprised all relevant agents with a slight preference of the on-patent agents atorvastatin and fluvastatin.

Conclusion: Hospitalisation exerts a marked influence on drug therapy in ambulatory care. Thereby a change towards on-patent drugs occur despite less pricey alternatives. Out-patient prescription data are suitable to describe these changes.

Introduction

The division of health care in a primary and secondary care sector is often alleged for a discontinuity in pharmacotherapy [1 - 3]. Possible consequences are uncertainty of patients getting another medication from their general practitioners (GPs) after discharge and of the GPs, because of marked deficiencies in reporting the discharge medication [4].

Moreover these changes may have an important economic impact due to other incentives for economic advantageous behaviour in primary and secondary care. In hospitals usually drug formularies are used [5] and price negotiations take place for the listed drugs. It appears undisputed that manufacturers allow high discounts for hospitals on newly launched on-patent drugs especially for chronic treatment. On contrary, in the ambulatory sector prices of drugs as well as the drug budget of the office-based physicians are strictly regulated. A hospital-initiated therapy with novel drugs is therefore a burden for the budget of the single GP and of course the purchaser of health care [6]. This is of special interest for so called Me-Too-drugs, that offers no considerable advantages to drugs already on market, but might be much more expensive [7].

Most studies performed so far on the influence of hospitalisation on discontinuation of drug therapy are based on questionnaires and deal with rather small patient numbers. Moreover, there are few data about the influence of a hospital admission on general aspects of drug prescription in the ambulatory sector on an unselected population [2]. Most studies were performed either on selected populations such as elderly patients and / or chronic patients [5, 8, 9]. Other studies have only been interested in special therapy [10 - 12].

The first aim of the study was to describe the overall influence of hospitalisation on the prescription of drugs in outpatient care. Therefore all prescriptions of the insured of one statutory health insurance (SHI) made within a three month time frame before admission and after discharge were analysed. The second aim was to evaluate an influence of hospitalisation on prescription of two examples of drugs often designated as Me-Too-drugs, namely those with the active substances atorvastatin and

pantoprazole. These were the two top selling drugs in the federal state this data were collected at the time of analysis [13].

Methods

Data: The database for the investigation consists of drug prescription data from the 4th quarter 2003 till the 2nd quarter 2004. Data are from all insured of a single German SHI, that had at least one hospital stay in a specific hospital in the 1st quarter 2004. The hospital is the only one in the district. Data records consist of an anonymized identification number of the insured, the dates of hospital-admission and -discharge, the central pharmaceutical number - an identification number of the finished drug -, and the number and the date of prescriptions. For the presented study the prescriptions done up to either three months (<= 91 days) before or after hospitalisation for each patient were analysed. For those patients with more than one hospitalisation within the first three months of 2004, prescriptions done before the first and after the last hospital stay were taken into account. Brand name, package size (indicated as N1 - N3), prices of the drugs and groups for calculation of aut-idem-savings potential were taken from the pharmacy price schedule (Große Deutsche Spezialitätentaxe, ABDATA-Base, Eschborn). The indicated costs are gross-costs and included allowances or payments by the insured.

Analysis: Original prescription data were connected to the ATC-Code (German Institute of Medical Documentation and Information, Cologne) for the active substance and the pharmacy price schedule (for price, brand name, package size) and most of the analysis was performed using standard software (SQL Query Analyzer Version SQL 8.00.194; Microsoft Office 2000 professional). Analysis of changes on an individual level before admission vs. after discharge was done using Wilcoxon's signed rank test for two paired dependent samples and additional statistical analysis with EpiInfo Vers. 3.3.2. In general all prescriptions in the analysed time frame were taken into account. In addition, for detailed analysis of prescriptions of statins and PPI we analyse only the last prescription of the respective group before admission and the first after discharge.

Results

Database

In total 2,848 patients had a hospital admission and discharge in the first quarter of 2004, 85.2% (2,426) from that had prescriptions of drugs before and after the hospitalisation within the analysed time frame. From 254 and 168 patients we had only data from before admission and after discharge, respectively. This can result from cancelling all drugs or the first-time prescription after discharge, but dying of the patient, removal, or the change of the SHI are other possible reasons. We do not have any information about this and included only those 2,426 insured into further analysis, where we are aware of their drug prescriptions. From these 2,044 had one and 382 had at least two stays within the hospital.

Overview about prescriptions

The total number of prescriptions was similar before and after hospitalisation (20,320 and 19,995, respectively; -1.6%) with mean number of prescriptions per patient of 8.38 and 8.24, respectively ($p=0.183$; see Table 1). However the mean costs per patient rose from 385 € in the three months before the hospital stay to 442 € in the three month afterwards ($p<0.001$), so that the overall costs for the investigated patients increased from 931,428 € to 1,069,569 € (+15%).

This total increase was due to an increase in the average costs per prescription from 45.84 € to 53.49 € (+17%). Whereas a sharp decrease in the prescription of drugs with costs of less than 10 € was observed in the time frame after discharge (-76%), in the other price segments there was an increase. This was most markedly for drugs with costs of more than 1000 €, that account for only 0.2% of all prescriptions, but 8% of all costs and 30% of the increase in costs after hospitalisation.

Corresponding to the increase in costs per prescription after discharge we found an increase in prescriptions and particularly costs in those main therapeutic groups with high costs per prescription, namely antineoplastic and immunomodulating agents,

and drugs concerning blood and blood forming organs (Table 2), that include antianemic and antithrombotic agents as well parenteral nutrition. Within the drugs concerning the musculo-skeletal system a decrease in the number of prescriptions was accompanied with an increase in total costs (Table 2). This was due to less prescriptions of non-selective non-steroidal anti-inflammatory drugs (NSAIDs) especially diclofenac, but more prescriptions of the coxibs, especially rofecoxib (data not shown).

Albeit we did not analyse the rates of generic preparations in detail for all groups, we calculated the aut-idem-savings potential due to generics and reimports. The mean savings potential per patient increased by 5.9% after discharge ($p=0.022$) leading to a total increase from 46,816 € before to 49,586 € and after hospitalisation. However, because the overall costs increased to a greater extend, the relative savings potential per patient as portion of the total costs decreased from 5.0% to 4.6% ($p<0.017$).

Changes of prescriptions on an individual level

After hospitalisation the number of different active substances prescribed per patient decreased moderately, but significantly from 5.62 before to 5.38 after hospitalisation ($p <0.001$), especially due to less patients getting more than 10 different active substances (11.9% vs. 8.5%). The overall changes within the medication were more prominent: 60% of the patients had at least 5 and 10% more than 10 changes in their prescribed agents, while only 1.9% had no change at all (Figure 1). Altogether 57% of all active substances prescribed to an individual before admission were cancelled after discharge, whereas 55% of all agents prescribed after a hospital stay were newly started. These changes affected all main groups according to the ATC-Code, and even when looking only at largest package sizes (N3), which can usually be used as an indicator for chronic treatment, more than 50% of all agents were cancelled and newly started after discharge.

Prescription of HMG CoA reductase inhibitors

In the observed group simvastatin was the predominant HMG CoA reductase inhibitors (statin) followed by atorvastatin. After discharge statins were prescribed to more patients than before the admission (+16%). A detailed analysis looking only at the last prescription of a statin before admission and the first after discharge revealed increases in patient numbers from 13% for simvastatin up to 23% and 24% for atorvastatin and fluvastatin, respectively (Table 3). Only half of the patients with statins afterwards had any statin-prescriptions before admission as well. A switch from one statin to another occurred only in 5% of the statin-prescriptions. Therefore the slightly larger increase in the patient number getting atorvastatin in comparison with simvastatin was due to patients where a statin therapy was newly started after discharge, but not to a change from other statins to atorvastatin. For simvastatin generics with comparable low costs are available and the rates of generics were 92% before and 96% after hospitalisation.

Prescription of proton pump inhibitors

After hospitalisation clearly more patients were on treatment with proton pump inhibitors (PPIs, +27%), and pantoprazole is the predominant PPI already in the pre-inpatient time frame. In the detailed analysis of the last PPI-prescription before admission and the first after discharge, the number of patients getting pantoprazole further increased strikingly (+58%), whereas no effect was detectable for the only PPI available as a generic, omeprazole, or the other members of this drug family (Table 4). Again, nearly half of the patients with a PPI-therapy after hospitalisation did not have such a medication before admission and in those patient with a newly started PPI-therapy the rate of pantoprozole was particularly high (64%; 132 of 207, Table 4). Both, before admission and after discharge, more than 96% of the prescriptions of omeprazole were generics.

Discussion

Discontinuation of drug therapy at the interface of primary and secondary care is a known phenomenon and several efforts are made to ensure care as a continuum at

the interface between the two sectors [14, 15]. Nevertheless, our data demonstrate that hospitalisation is accompanied with marked changes in pharmacotherapy with more than half of all prescribed substances changed after hospitalisation.

One major advantage of the presented analysis is the broad data basis with all prescriptions to most patients of one SHI being in-patient within a three-month period. Because the chosen hospital is the only one in the region and has a broad catchment area, the data give a valid and representative overview about the ambulatory prescriptions to patients that underwent hospitalisation in the particular area and about their changes in medication, too.

We do not have patient diagnosis or any data from the hospital stay and therefore do not make any assumptions if the observed changes are medically indicated. Moreover, the observed changes can only be partially attributed to the hospital stay, because changes of the discharge medication occur as well [3, 16, 17]. However, the changes observed by us are roughly in accordance with those reported by others [2, 8] and the explicit increase in medication used for acute or severe illnesses like anticancer therapy, antianemic and antithrombotic agents, or parenteral nutrition indicates that the observed changes are largely attributable to the hospitalisation. This is in accordance with the finding that for pivotal indications, family doctors widely follows the discharge recommendation [5]. Moreover, in the detailed analysis of PPI and statins, the effect of changes in the primary care sector on the results was reduced by looking only at the last prescription out of the selected drug families before admission and the first after discharge.

One difficulty in the interpretation of the data results from changes in social security legislation at the beginning of 2004 in Germany that affects mainly the post-inpatient time frame [18]. As a result over-the-counter drugs were withdrawn from the benefits catalogue of the SHI and low-priced prescription-only medicine got more expensive, whereas prices from expensive drugs decreased. The sharp decrease in the number of drugs with prices up to 10 € after hospitalisation can be ascribed to this. Therefore the drop of OTC-drugs can mask an increase in the number of prescriptions initiated by the hospital.

After hospitalisation the overall savings potential due to generic preparations increased to a lesser extend than the overall costs, indicating no switch from generics to original preparations with the same active substance on a large scale.

The data indicate an increase of novel on-patent drugs with questionable therapeutic advantages over off-patent alternatives at the interface between secondary and primary care. The number of patients getting pantoprazole after hospitalisation increased markedly mainly due to patients with a first-time PPI medication after discharge, whereas the number of those getting omeprazole, the only PPI available as generic, remained unchanged. This discrepancy is a strong indicator for a primarily use of pantoprazole in the hospital and a relevant influence of the discharge medication on the prescription of PPIs in primary care. The differences in effectiveness or side effects of the different PPIs are presumed to be marginal [19] and the usage of pantoprazole in secondary care may not be based on scientific evaluations only. An increase of PPIs after hospitalisation was observed as well by others, who estimate that they are over-used in hospitalised patients and argued that this induce inappropriate drug consumption in general practice as well [10, 20]. Comparable results as for PPIs we found for the NSAIDs, where the number of patients getting the on-patent COX-2 specific agent rofecoxib increased considerable, while that getting the inexpensive non selective NSAID diclofenac decreased. Coxibs are thought to be safer than non-selective alternatives in some patients, however, not only patients where non-selective NSAIDs were not suitable accounted for the increase in the total growth of the rofecoxib use [21].

Cardiovascular diseases are the main reason for admission into hospital and statins are recommended for the affected patients [22]. Therefore the overall increase in the number of patients under therapy was expected [11]. Despite better evidence for the efficacy of simvastatin [23], where generics are available, the post-inpatient increase was higher for the two on-patent statins, atorvastatin and fluvastatin. Taken together, after hospitalisation the substances of three out of the four most selling drugs - atorvastatin, pantoprazole, and rofecoxib [13] - showed a more pronounced increase in patient numbers than other therapeutic options with generic alternatives.

The aimed integrated drug supply at the interface between primary and secondary care is not yet reality. More efforts, especially comprehensive communication structures and shared drug formularies, are needed to achieve it [24 - 26]. At least in some economic relevant therapeutic areas medication changes after discharge towards on-patent drugs despite appropriate alternatives with off-patent or generic drugs. Therefore, at least from the view of the health care purchaser, arrangements about a harmonisation in drug supply should include on-patent drugs frequently used in chronic diseases. Analysis of outpatient prescription data are a useful tool to evaluate such agreements.

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Table 1: Number of prescriptions and active substances and costs before and after hospitalisation

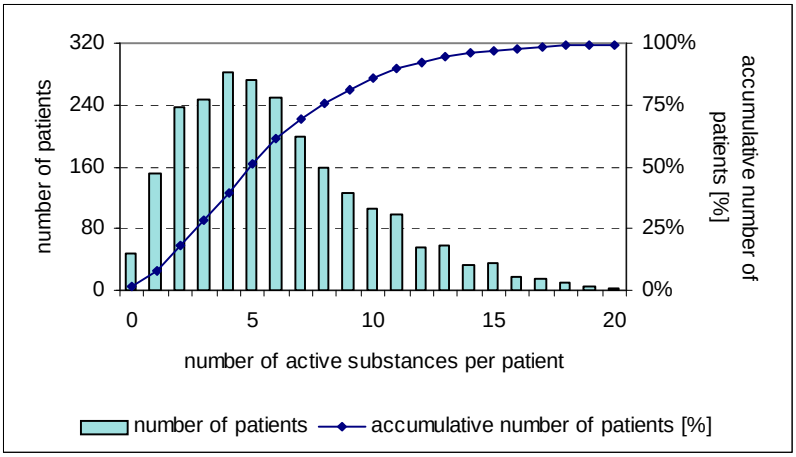
	before admission	after discharge	
number of patients	2,426	2,426	
total prescriptions	20,320	19,995	
mean number of prescriptions per patient	8.38	8.24	p = 0. 183
median number of prescriptions per patient	7	7	
total number of different active substances	825	811	
mean number of active substances per patient	5.62	5.38	p < 0.001
median number of active substances per patient	5	5	
total costs [€]	931,428	1,069,569	
mean costs per patient [€]	385	442	p < 0.001
median costs per patient [€]	202	251	
average costs per prescription* [€]	45.84	53.49	

* For some drugs like receipts made within the pharmacy there are no prices listed in the pharmacy price schedule; therefore the costs per prescription is based on the 19,957 prescriptions before and 19,577 after the stay with prices available; p-value for Wilcoxon's signed rank test for two paired dependent samples.

Table 2: Number of prescriptions, costs and costs per prescription within different drug groups before admission and after discharge

	number of prescriptions			**costs [€]**			**cost per prescription [€]**		
main group (anatomical group according to the ATC-Code)	**before admission**	**after discharge**	**changes**	**before admission**	**after discharge**	**changes**	**before admission**	**after discharge**	**changes**
Cardiovascular system	5.300	5.181	-2%	209.249	204.409	-2%	39	39	0%
Alimentary tract and metabolism	3.383	3.100	-8%	167.634	164.010	-2%	50	53	7%
Nervous system	2.843	3.073	8%	165.442	190.193	15%	58	62	6%
Musculo-skeletal system	1.507	1.342	-11%	55.674	59.814	7%	37	45	21%
Blood and blood forming organs	1.472	1.604	9%	117.115	187.725	60%	80	117	47%
Respiratory system	1.561	1.273	-18%	36.991	32.870	-11%	24	26	9%
Sensory organs	673	723	7%	12.357	15.673	27%	18	22	18%
Anti-infectives for systemic use	696	686	-1%	18.081	20.879	15%	26	30	17%
Antineoplastic and immunomodulating agents	152	236	55%	45.561	87.179	91%	300	369	23%
other	2.733	2.777	1%	103.325	106.817	5%	38	38	2%
sum of all	**20.320**	**19.995**	**-2%**	**931.428**	**1.069.569**	**15%**	**46**	**53**	**17%**

Figure 1:



Absolute number (boxes) and accumulative proportion (line) of patients in dependence of the number of active substances changed per patients after discharge.

Table 3: Numbers of patients with prescriptions of HMG CoA reductase inhibitors before admission or after discharge

		Simvastatine	Lovastatine	Pravastatine	Fluvastatine	Atorvastatine	all statins
patients with statins before admission		**175**	**8**	**41**	**34**	**103**	**361**
statin cancelled		81 (46%)	6 (75%)	16 (39%)	12 (35%)	39 (38%)	154 (43%)
patients with statin after hospital stay		**197**	**5**	**48**	**42**	**127**	**419**
same statin before		89 (45%)	2 (40%)	23 (48%)	20 (48%)	54 (43%)	188 (45%)
statin new	**other before**	12 (6%)	1 (20%)	1 (2%)	2 (5%)	3 (2%)	19 (5%)
	none before	96 (49%)	2 (40%)	24 (50%)	20 (48%)	70 (55%)	212 (51%)
Relative Risk getting the statin after discharge		**1.126**	**0.625**	**1.171**	**1.235**	**1.233**	**1.161**
CI (95%)		0.926 - 1.369	0.205 - 1.908	0.775 - 1.769	0.789 - 1.935	0.957 - 1.589	1.02 - 1.321

Note: For each patient only the last prescription of a HMG CoA reductase inhibitor before admission and the first after discharge was counted.

Table 4: Numbers of patients with prescriptions of proton pump inhibitors before admission or after discharge

		Omeprazole	Pantoprazole	Lansoprazole	Rabeprazole	Esomeprazole	all PPIs
patients with PPI before admission		**107**	**161**	**15**	**1**	**59**	**343**
statin cancelled		40 (37%)	46 (29%)	4 (27%)		24 (41%)	114 (33%)
patients with PPI after discharge		**111**	**255**	**9**	**1**	**60**	**436**
same PPI before		56 (50%)	108 (42%)	8 (89%)	1 (100%)	27 (45%)	188 (46%)
PPI new	**other before**	7 (6%)	15 (6%)	-	-	7 (12%)	29 (7%)
	none before	48 (43%)	132 (52%)	1 (11%)	-	26 (43%)	207 (47%)
Relative Risk getting the PPI after discharge		**1.037**	**1.584**	**0.6**	**1**	**1.017**	**1.271**
CI (95%)		0.8 - 1.345	1.311 - 1.914	0.263 - 1.368	0.063 - 15.979	0.713 - 1.45	1.116 - 1.447

Note: For each patient only the last prescription of a proton pump inhibitor before admission and the first after discharge was counted.

3 FURTHER ASSESSMENT AND DISCUSSION

Regardless of the division of the health care system in an outpatient primary sector and secondary care in the hospitals, health care provision for the individual patient should be carried out as a continuum. This applies for the provision with pharmaceuticals as well, which play a major role in particular in the treatment of patients with chronic diseases. Nevertheless our data indicate that the aim of an integrated care is not yet achieved between the two sectors.

3.1 The impact of hospitalisation on drug therapy: Analysis from ambulatory drug prescriptions

We found considerable alterations in drug therapy for nearly every patient. In about 50% of all patients at least 3, and in about 25% at least 5 agents prescribed before admission were cancelled, and nearly to the same rates substances were prescribed newly to an individual (Figure A-1). Altogether, there have only been 47 out of the analysed 2.426 patients (1.94%), without any change in agents.

Because we have analysed prescription data only from the office-based physicians, we can conclude only from indirect evidence and do not know what has happened in the hospital. We cannot distinguish between changes made at admission within the hospital or those initiated after discharge by the office based physician. At the first glance we might therefore overestimate the effect of the hospital. However a GP either modify a hospital initiated therapy and than these changes occurred in the context with the stay, or he continue his former medication irrespectively of another hospital recommendation (Cochrane et al. 1991, Adl et al. 2001), and in these cases we will not realise any change in therapy. Moreover we cannot comment on the background of a prescription or an observed change in therapy and we do not assume that all alterations can be attributed to hospitalisation. Nevertheless, the analysis of prescriptions of the largest package sizes only (indicated as N3) revealed similar results than the overall evaluation, indicating that major changes occurred in

drugs used for a chronic treatment, where usually only minor changes are expected (Table A-1, Figure A-2).

Our data appears reasonable for two other causes as well: firstly, looking at the main group of drugs according to the ATC-Code the increase in prescription occurred mainly for drugs used for severe diseases making an inpatient care necessary, like anticancer therapeutics (antineoplastic and immunomodulating substances) or parenteral nutrition and antithrombotic drugs (blood and blood forming organs) (Figure A-2). Moreover on an individual level discontinuation was observed most for anti-infectives for systemic use, where a chronic therapy is seldom, whereas a continuation was most frequent for substances used in the treatment of cardiovascular diseases, that is usually a chronic therapy (Table A-3).

Secondly, the rate of changes in medication noticed in our analysis is in quite good agreement to that reported in the literature. So Beers et al. found that 40% of all admission medications were discontinued and 45% of all discharge medications were newly started during the hospitalisation (Beers et al. 1989). Others as well report changes in the rate of roughly about 50% of all drugs either at admission (Himmel et al. 1996a, Himmel et al. 2004) or after discharge (Adl et al. 2001, Hach et al. 2005, Harder et al. 2005, Stuffken and Egberts 2004). Thereby we focused on active substances only, and do not report on changes in dosage or manufacturer. The relevance of such changes are difficult to interpret: office based physicians in Germany are allowed to prescribe only the active ingredient and the decision about the manufacturer is made by the pharmacists, or drugs are divided and a change in dosage is only pretended. Taking these factors into account as well, the proportion in changes is even higher in our analysis.

The good agreement of our results with that of others is noteworthy, because in general information about the changes in medication is gained from discharge summaries or by asking either physicians or patients with questionnaires. This offers of course advantages, especially the time of changing can be specified more accurately and a reason for a change can be asked. Moreover we miss in the analysis those drugs not prescribed at the expense of the SHI, e.g. nearly all over the counter drugs, but changes occur here as well. As we do not have any information

about the patient, neither diagnosis, age nor the hospital department where he was treated, we cannot comment on the changes on an individual level. Again, this might be possible when getting the data by a asking patients or the attending physicians.

On the other hand it is much easier to obtain a representative database by a computerised analysis of prescription data only, and most published studies therefore deal with ten percent or even less of the number of patients in our analysis. We excluded only those patients without any prescribed medication at all in the observed time frame either before or after hospitalisation, because we do not know if these have newly entered or left, respectively, the cohort under investigation. Because 2,426 of the total of 2,848 patients received drugs as well before as after hospitalisation, we can comment on 85% of all patients of the respective SHI being inward within the chosen quarter, and the rate of the analysed prescriptions and costs is even about 94% (Table A-4). Therefore we have a very good database about the overall medication of patients before admission and after discharge, and therefore are able to assess the influence of hospitalisation as a whole. At least if there is only one regional hospital the office-based physicians refer their patients, such an analysis offers moreover the opportunity to evaluate the influence of secondary care of a specific hospital.

We had prescription data from the last quarter in 2003 to the second quarter in 2004 of patients being inward in the first quarter 2004. We had therefore prescription data from at least three months before and after hospitalisation for every patient. Our analysis is based on this longest time frame possible for us, because it comprise the usually maximal time frame between two visits by a GP in chronic disease (once per quarter) and about the maximal time span for which a single package of drugs is prescribed. Shortening the time frame and looking only on a 30 days interval before and after hospitalisation of every patient, hold the risk that even a medication taken continuously is noticed only either before or after hospitalisation and therefore declared either as cancelled or newly prescribed. On the other hand, a longer time of observation increases the risk of changes in the ambulatory sector not associated with hospitalisation.

Taken together the approach to analyse prescription data from the ambulatory sector is feasible to gain information about drug changes at the interface between primary and secondary care sector.

3.2 Real and alleged impacts of hospital-initiated changes in medication on the ambulatory sector

While it is undisputed that hospitalisation is accompanied with major changes in drug therapy in outpatient care, the further effects are not as clear. These are explored in the presented analysis mainly concerning the number of prescriptions and different substances, and the economic impact.

3.2.1 The number of prescriptions and prescribed substances

In our analysis the total number of prescriptions before admission and after discharge remained unchanged, and an increase occurred only for specific therapeutics, mainly in the field of anticancer therapy. Moreover the distribution of prescriptions per patient remained unchanged, with about one fourth of the patients had at least 3, 46% 4 to 10 and the remaining almost 30% more than 10 prescriptions as well before as after hospitalisation (Table A-5). These data are in good agreement with Beers et al., who as well report no differences in the overall number of drugs from admission to discharge in sum, but an increase only in specific areas (Beers et al. 1989). Thereby the overall number of different active ingredients per patient even decreased in our cohort, especially due to a decline in the number of patients with more than 10 different compounds (Table A-6). Therefore we cannot confirm reproaches made by Bausch (2005), who indicate a role of hospitalisation on the development of polypharmacy, but rather see an opposite effect. An important role of the ambulatory sector on the increase in drug consumption is indicated moreover by findings that the most frequent change after hospitalisation was the additional prescribing of drug groups (Adl et al. 2001) or the increase concerning some problematic agents like benzodiazepines during the ambulatory follow-up (Harder et al 2005).

Taken together hospitalisation is only of minor relevance for the number of prescriptions and cannot be alleged for the development of polypharmacy.

3.2.2 The structure of prescriptions and economic effects

In accordance with reports from others we found that hospitalisation lead to an increase in the costs for drug therapy and this indicates that hospital-initiated prescriptions are responsible for a significant proportion in cost of outpatient prescribing (Feely et al. 1999, Hakansson et al. 2001). Because the number of prescriptions remained unchained, the raise in expenses is due to alterations in the structure of drug therapy with higher costs per prescription. This change in the structure might be medically reasonable, as the main fields of cost increase account for very expensive special therapeutics. So the expenditures for drugs with prices over 1000 € doubled nearly after hospitalisation and despite accounting only for 0.2% of all prescriptions make up 30% of the cost increase after discharge (Table A-7). Within this specialised care potential savings are difficult to be realised without a loss in the quality of care.

Nevertheless, savings are realistic in other therapeutic fields. We could demonstrate an effect of hospitalisation on the prescription of economic relevant therapeutic groups with an increase of on-patent drugs in comparison to off-patent alternatives. This was most obvious looking at the PPIs with a substantial increase in the patient number getting pantoprazole, and no change in those getting omeprazole, where generic alternatives are available (Table A-8, Table A-9). It was visible for the statins as well, where the increase in patient numbers was more pronounced for the only on-patent members of this drug family, atorvastatin and fluvastatin, than for simvastatin, despite the fact that the effectiveness of the latter one is better proven (Institut für Qualität und Wirtschaftlichkeit im Gesundheitswesen 2006) (Table A-10, Table A-11). These data are in accordance with others showing an increase in the use of PPIs and statins after hospitalisation (Jones et al. 2001b, Nardino et al. 2000; Parente et al. 2003, Schroder-Bernhardi and Dietlein 2002). The increase of especially the on-patent members of the groups is a strong indicator for the often noted effect that

hospital initiated therapy is important for the introduction of novel and often expensive drugs onto the market (Sachverständigenrat zur Begutachtung der Entwicklung im Gesundheitswesen 2005).

The reproaches that hospitals are responsible for an increase in pharmaceutical expenditures are not new and came not only from the SHI, but were raised from the office based physicians or the Association of Statutory Health Insurance Physicians (Kassenärztliche Vereinigung) already some years ago (Haffke 2001). With the Act on the Limitation of Pharmaceutical Expenditure (Arzneimittelausgabenbegrenzungs-gesetz, Bundesgesetzblatt 2002) a new article was introduced into the social security legislation (§115c, Book V of the Social Code) to regulate the continuation of the drug therapy after hospitalisation. Thereafter the hospital is obliged to inform the office-based physician about the discharge recommendation by using the names of the substances of the drugs. Moreover the hospitals have to give low-priced alternatives if substances with comparable action are available. This legal initiative point up that the legislator was aware of the problem of expensive drug therapy initiated in the hospital. However, it can be doubt that hospitals yet changed their recommendations. So in a study by Roth-Isigkeit and Harder the majority of the GPs (82%) quoted that in the short notification handed over to the patient at discharge only brand names are given and neither the generic name nor any further information on generic substitution is available. About two third of the responders quoted that even in the more detailed discharge letter only brand names are given (Roth-Isigkeit and Harder 2005). Under the impression of growing expenses for pharmaceuticals in the ambulatory care within the last year and the risk of even more regulations and narrower drug budgets for the individual office based physician with the accompanied risk of regresses, the role of hospital recommendations concerning the drug therapy got into focus of the physician association again (Schott 2005; Bausch 2005). As described our data indicate indeed, that hospitalisation lead to an increase of expensive drugs where generic alternatives are available and that therefore the hospitals do not meet the demands introduced by the Act on the Limitation of Pharmaceutical Expenditure. In the just adopted new cost dampening measure (Arzneimittelversorgungs Wirtschaftlichkeitsgesetz, Economic Optimisation of

Pharmaceutical Care Act; Deutscher Bundestag 2006) it is explicit mentioned, that the discharge medication of the hospital have to be suitable for an economic prescription in the ambulatory care sector as well. Moreover, now the SHI is allowed to cut the hospital budget, if these do not meet their requirements.

Without putting the effect of the hospital into question, two points should be kept in mind: Firstly, of course not all prescriptions of new drugs are initiated by the hospitals. Jones et al. even proposed, that consultants prescribe fewer new drugs and these only in their speciality and according to scientific evidence. GPs on the contrary were found to prescribe more new drugs for a much wider range of conditions and use drug company representatives as a major source for information (Jones et al. 2001a). This is in accordance with the finding that economic reasons are of minor relevance for changes of the discharge medication in the primary care sector (Adl et al. 2001, Hach et al. 2005). And secondly the detailed analysis within the PPI and statins shows that a change from one member to another of the same drug family occurs only in rare cases and therefore is of minor relevance. Despite the clear influence of hospitalisation towards an increase of the prescription of pantoprazole, only in 15 out of 255 (5.9%) patients with pantoprazole after discharge a change from another PPI taken before admission occurred, while there were 7 out of 161 patients (4.3%) with pantoprazole before admission and another PPI after discharge. Looking at the statins a direct change from atorvastatin to simvastatin occurred even in more cases than the other way round (9 vs. 3 patients), despite the overall higher increase for atorvastatin. These findings appear astonishing, because hospitals in general will use only their listed members of drugs - e.g. only pantoprazole as a PPI - and indicate a continuation of a therapy with the drug used before admission by the office based physician. However, independent of the chosen drug in the hospital - and we cannot commend on this at all -, looking only at the outpatient therapy after discharge, hospitalisation can not be blamed for a change of a therapy from an off-patent member of the investigated substance classes to a more pricey, on-patent Me-Too-substance. Moreover, as there was no increase in the generic savings potential, no relevant change towards the use of drugs with the same substance, but a higher sales price, occurred as a result of hospitalisation, too (Table A-12).

An overall economic influence of hospitalisation is based therefore on the initiation of drug therapy rather than on the change of a given medication towards more expensive alternatives. This alone may be sufficient for a relevant effect because of the high portion of newly started therapy after discharge, but reliable estimations are difficult to obtain. In our analysis in 132 patients from a total of 2.848 a therapy was started with pantoprazole after discharge, and in 90 with one of the on-patent statins atorvastatin or fluvastatin. These are 4.6 % and 3.1 %, respectively, of the unselected cohort of all patients with a hospitalisation. Taken into account that about 20% of the whole population underwent a hospitalisation each year (Statistisches Bundesamt 2005), a sizeable influence of hospitalisation is very likely, even under consideration that these therapies are initiated in the ambulatory sector independent from secondary care as well.

3.3 Efforts for an integrated care

Altogether it can be doubt that a harmonisation of drug therapy can be reached by shifting the blame on either the ambulatory or the hospital sector. More prospects of success lie in approaches where the different care provider act together on an integrated and economic reasonable care. One such project was implemented between a major health insurance fund, GPs and internal wards of all hospitals within a federal state in Austria (Wolzt et al. 2003). The project called “Bessere Therapie zu einem besseren Preis” (“Better therapy for better costs”) started with a consensual analysis of the regional prescription patterns, followed by a voluntary agreement on prescription of a cheaper generic for the to that time most cost-intensive ACE-inhibitor enalapril as well at the internal medicine wards as in primary care. The authors conclude that consensus based projects are appropriate pharmacoeconomic interventions to change prescription patterns, increase the use of necessary drugs and reduce the increasing cost requirements (Wolzt et al. 2003). To avoid changes in therapy during the hospitalisation only those patients were treated with the generic, where an ACE-inhibitor therapy was initiated. In the light of a change of about the half

of all prescribed drugs in connection with hospitalisation such an approach seems to be effective enough and is therefore in terms of an integrated care favourable.

A project with the focus even more on an integrated care has started lately in Germany with one university hospital, about 40 GPs and a single SHI as participants (HeiCare-Project, Lisson 2005, Universitätsklinikum Heidelberg 2005). GPs and hospitals agree about continuation of the initiated therapy wherever medically indicated and so the aim of a harmonisation of drug therapy should be reached. Office based and hospital physicians are supported by a computer-based information system to detect possible interactions. GPs will moreover be informed about changes in the medication in advance before discharge and can discuss them with the attending physician an the ward. This shows that one major point within this project is to improve the communication between the two sectors. The better communication is of special meaning in light of data showing that GPs received detailed information about drug changes in only less than 5% of all cases after discharge (Himmel et al. 1996b, Roth-Isigkeit and Harder 2005). The GP can therefore hardly assess why a new therapy was started and if it warrant higher costs. Moreover in the discharge summary still often the brand names are used. Therefore even if the GP use the same active ingredient after discharge but a generic preparation he have to explain the patient why he do not prescribe the same drug that was effective in the hospital. A better communication between GP and hospital seems to be of increasing importance at the background of rising complexity of therapeutic regimes and shortened duration of hospitalisation.

The importance to involve the different parts of health provision is emphasised by the failure of models involving pharmacists but not the office-based physicians (Staeck 2005). On the other hand it is possible to involve pharmacists in the hospitals to look at interactions or economic reasonable alternatives. A role that has advanced implications for the treatment will probably not be accepted by the physicians.

3.4 Outlook

The major aim to reach an integrated care should be the development of a common drug formulary - or even better common guidelines for therapy - based on common recommendations of the physicians that refer their patients into the hospital and the hospital physicians. Changes in medication on the interface between primary and secondary care should be minimised by such a programme (Duerden and Walley 1999). So far legal initiatives failed to overcome the division in drug therapy between the care sectors, and the future will show if the new Economic Optimisation of Pharmaceutical Care Act (Deutscher Bundestag 2006) ease this. However, up to now initiatives on a regional area will have more chances of success.

For such a programme the attendance of at least one hospital and a sufficient number of office based physicians is necessary. The office-based physicians mainly perform overall care and drug therapy. Therefore any programme at least in Germany have to acknowledge their prominent point in therapy. SHI may play a major role in initiating and co-ordinating such a programme. Moreover economic incentives for the hospitals should be considered, at least the substitution of before used drugs have to be without any financial burden for the hospitals.

Hospitals especially in a competitive surrounding with providers of secondary care will have advantages due to preferred referrals from the GPs. For the GPs a harmonised therapy can be incentive enough, because less expensive discharge recommendation might relieve problems concerning their drug budget and the physicians moreover gain time otherwise used for explaining changes in drug treatment. However registration fees might be useful, at least as a refund for potential additional documentation. The SHI might profit from a more rational and possibly more economic pharmacotherapy. And last not least, of course patients would benefit from such a harmonisation because of less confusing drug changes and therefore a saver and better treatment.

An analysis as the presented is able to describe the effect of hospitalisation on drug prescription in the ambulatory sector. If, as it was the case here, moreover the hospital is the only regional one, it is suitable to describe even the influence of a

specific hospital. Those measurements are therefore useful to evaluate the effects of an initiated programme on a harmonisation of drug therapy at the interface between primary and secondary care sector.

4 ABSTRACT **(copy of the abstract from: 2 Article)**

Objective: To explore the influence of hospitalisation on the prescription of drugs in the primary care sector, particularly on HMG CoA reductase inhibitors (statins) and proton pump inhibitors (PPIs).

Methods: Analysis of outpatient drug prescriptions of members of a statutory health insurance that were inpatient in the I. quarter 2004. Prescriptions done within three months before admission or after discharge were analysed. Drugs were coded with central pharmaceutical number, active substances and costs were linked with the ATC-Code and the pharmacy price schedule, respectively.

Results: 2,426 patients received drugs before and after hospitalisation. After discharge the mean number of prescription per patient remained unchanged, while the number of different active substances decreased (-4%). Still overall costs increased after discharge due to higher costs per prescription (+17%). Changes in medication affected nearly every patient, and more than 50% of all substances prescribed to an individual before admission or after discharge were cancelled or newly started, respectively. In both therapeutic subgroups analysed in detail, PPIs and statins, significant increases in the number of patients under therapy occurred (+27% and +16%, respectively). The increase in PPI-medication was due to a 58% rise in the number of patients getting pantoprazole, while that for statins comprised all relevant agents with a slight preference of the on-patent agents atorvastatin and fluvastatin.

Conclusion: Hospitalisation exerts a marked influence on drug therapy in ambulatory care. Thereby a change towards on-patent drugs occur despite less pricey alternatives. Out-patient prescription data are suitable to describe these changes.

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