

Effects of an Automated Electronic Reminder in Changing the Antiplatelet Drug-Prescribing Behavior Among Italian General Practitioners in Diabetic Patients

An intervention trial

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OBJECTIVE — To evaluate whether an electronic reminder integrated into a routine computer system increases the use of antiplatelet drugs for diabetic patients among Italian general practitioners (GPs).

RESEARCH DESIGN AND METHODS — A randomized controlled trial was carried out among 300 GPs and their patients selected from the Health Search Database. Among these, 150 GPs (intervention group) received instructions to activate an electronic reminder plus a letter summarizing the beneficial effects of antiplatelet drugs in diabetic patients with at least one additional cardiovascular risk factor (“high risk”), whereas the other 150 GPs (control group) received only the letter. The electronic reminder, integrated into a standard software system for the management of the daily clinical practice, was displayed when every participating GP opened the medical record of diabetic patients aged ≥ 30 years. Only high-risk diabetic patients were included in the analysis. Patients were considered under antiplatelet treatment if they received two or more prescriptions at baseline and during the follow-up.

RESULTS — We selected 15,343 high-risk diabetic patients, 7,313 belonging to GPs of the control group and 8,030 belonging to GPs of the intervention group. Overall, 1,672 patients (22.9%) of the control group and 1,886 (23.5%) patients of the intervention group received antiplatelet drugs at baseline ($P = \text{N.S.}$). At the end of the follow-up, the number of treated patients was significantly increased in the intervention group (odds ratio 1.99, 95% CI 1.79–2.22) versus the control group. The effect of the electronic reminder was more relevant among those patients with one or more cardiovascular risk factors but without previous cardiovascular diseases (CVDs), compared with those with CVDs.

CONCLUSIONS — These findings provide evidence for the effect of an electronic reminder in affecting the prescriptive behavior of GPs.

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Several trials have demonstrated that antiplatelet drug therapy can prevent either the first (primary prevention) or subsequent (secondary prevention) cardiovascular events, such as coronary heart disease and stroke, without any significant increase in adverse events (1,2). These findings are reflected in

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Abbreviations: ATC, Anatomical Therapeutic Chemical; CVD, cardiovascular disease; GP, general practitioner; HSD, Health Search Database.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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guidelines produced by national and international task forces (3,4). Nevertheless, prescription rates of antiplatelet drugs in diabetic patients still remain generally below the recommended targets (5). Passive methods of disseminating and implementing guidelines by publication in professional journals or mailing to targeted health care professionals rarely lead to changes in prescribing behavior in routine practice (6).

To improve the performance of physicians and patient outcomes, the use of patient-specific prompts at the time of the consultation has been suggested (7). This approach can be achieved with a computerized support system for decision making. However, most of the studies thus far reported had flaws in their design or analysis, so the results should be interpreted with caution. Moreover, there are no studies aimed at assessing the effectiveness of electronic prompts integrated into routine computer systems specifically designed for primary care.

We therefore aimed at evaluating whether, among Italian general practitioners (GPs) using a standard software system for patient data management, an electronic reminder could increase the prescription of antiplatelet drugs in diabetic patients at high-risk to develop future cardiovascular disease (CVD).

RESEARCH DESIGN AND METHODS

Data source

The study was carried out in Italy between 1 May 2001 and 30 November 2001. Data were extracted from the Health Search Database (HSD), which is owned by the Italian College of General Practitioners. The HSD currently contains data from >550 Italian GPs, with a patient population of >800,000 individuals. After intensive training, all participating GPs had

to use specially designed software to record data during their normal daily clinical practice. The software system codes all of the diagnostic records by using the ICD-9 (8). Prescription records are also coded according to the Anatomical Therapeutic Chemical (ATC) classification system (9).

A unique identification number links patient demographic details, medical records (e.g., diagnoses, tests and test results, hospitalization, etc.) and drug therapy anonymously so that no identifying details are available. Data are subject to a number of quality checks, such as weekly number of consultation rates, completeness of prescription and prevention records, proportion of drug information linked to medical diagnosis, and completeness of mortality records. Data coming from physicians who failed to meet standard quality criteria are not considered for epidemiological studies (10,11).

Study design and power

For this study, only GPs who met the agreed ranges of data quality were selected. The sample size was calculated by assuming a prescription rate of antiplatelet drugs among diabetic patients ranging from 20 to 25% and an increase of 10% for the intervention group at the end of the study period. The power of the study was set at 0.90 ($\alpha = 0.05$). To achieve this aim, the number of patients needed was 15,000. Assuming an approximate 4.0% prevalence of diabetes, we then selected a total number of 300 GPs.

Among the participating GPs, 150 were randomly assigned to receive the instructions for activating an automated electronic reminder (intervention group) and the other 150 were assigned to the control group. All selected GPs then received a letter containing a summary of practice guidelines (4) illustrating 1) the beneficial effect of antiplatelet drugs among high-risk diabetic patients in primary and secondary prevention of CVD, and 2) an estimate of the rate of diabetic patients treated with antiplatelet drugs within the HSD. Physicians from the intervention group also received a letter with the instructions for activating an electronic reminder.

The characteristics of the electronic reminder were as follows: 1) it was activated when the participating GPs opened the medical record of diabetic patients aged ≥ 30 years; 2) the prompt contained

the sentence "Be aware! The patient might be at high risk to develop CVD. Take into account the possibility to prescribe antiplatelet drugs;" and 3) the reminder could be deactivated according to the physician's preferences.

Data collection

Data were extracted from computerized medical records and collected for all ever-recorded diabetic patients (ICD-9 code 250) aged ≥ 30 years from 12 months before ("baseline") to 7 months after the beginning of the observation period. We then excluded those patients without at least one of the following risk factors at baseline: 1) total cholesterol ≥ 5.2 mol/dl, 2) hypertension (diastolic blood pressure > 90 mm/Hg and systolic blood pressure > 140 mm/Hg), 3) cigarette smokers, and 4) presence of previous CVD. Patients without any consultation at baseline and during the follow-up were also excluded from the study. According to the number of detected risk factors, patients were then classified in the following risk groups: 1) patients with one risk factor and without CVD, 2) patients with more than one risk factor and concurrent CVD, and 3) patients with CVD. All prescriptions containing ATC code B01AC were considered as antiplatelet drugs. At baseline, only patients with two or more prescriptions were considered under treatment.

Statistical analysis

All randomized patients were included in the analysis on an intention-to-treat basis, regardless of whether the GPs of the intervention group truly activated the electronic reminder. We expressed effect size as the difference within the groups at baseline and at the end of the follow-up. To compare baseline with end follow-up within the control and intervention groups, we used Student's *t* test. For the primary end point, we used the odds ratio (OR) with 95% CIs, which allowed us to estimate the relative risk of increasing the number of patients under treatment with antiplatelet drugs using the electronic prompt, compared with the control group. Analyses were performed using STATA 6.0 statistical software (STATA, College Station, TX).

RESULTS— A total sample of 20,626 diabetic patients was extracted from the HSD, 10,973 belonging to GPs of the intervention group and 9,653 belonging to the GPs of the control group. The characteristics of the two groups are shown in Table 1. Among these, 5,283 were excluded either because of lack of any cardiovascular risk factor or because they did not receive any consultation at baseline or during the follow-up.

The final sample included 15,343 high-risk diabetic patients, 7,313 (47.7%) belonging to GPs of the interven-

Table 1—Demographic and clinical characteristics of the study sample assessed at baseline

	Control	Intervention
<i>n</i>	9,653	10,973
Sex		
Male	4,640 (48.1)	5,087 (46.3)
Female	5,013 (51.9)	5,886 (52.7)
Age (years)		
31–45	318 (3.3)	421 (3.8)
45–64	3,061 (31.7)	3,475 (31.7)
> 64	6,274 (65.0)	7,077 (64.5)
Concurrent diseases		
CVD	4,533 (47.0)	5,261 (47.9)
Hypertension	6,349 (65.8)	7,207 (65.7)
Smoking status		
Yes	2,026 (21.0)	2,130 (19.4)
No	4,713 (48.8)	6,000 (54.7)
Ex-smoker	2,914 (30.2)	2,843 (25.9)
Total cholesterol (> 5.2 mol/dl)	6,372 (66.0)	7,009 (63.9)
High-risk diabetic patients	7,313 (75.8)	8,030 (73.2)

Data are *n* (%).

Table 2—Number of high-risk diabetic patients with antiplatelet drug prescriptions at baseline and at the end of the follow-up

Type of risk*	Control				Intervention				
	High-risk diabetic subjects (n)	Antiplatelet users			High-risk diabetic subjects (n)	Antiplatelet users			
		Baseline (%)	Follow-up (%)	Effect size (%)		Baseline (%)	Follow-up (%)	Effect size (%)	OR (95% CI)
Group 1	2,578	263 (10.2)	440 (17.1)	177 (6.9)	2,651	358 (13.5)	736 (27.8)	378 (14.3)	2.38 (1.97–2.87)
Group 2	1,440	180 (12.5)	276 (19.2)	9.6 (6.7)	1,577	224 (14.2)	508 (32.2)	284 (18.0)	3.22 (2.52–4.12)
Group 3	3,295	1,229 (37.3)	1,526 (46.3)	297 (9.0)	3,802	1,304 (34.3)	1,768 (46.5)	464 (12.2)	1.36 (1.16–1.59)
Total	7,313	1,672 (22.9)	2,242 (30.7)	570 (7.8)†	8,030	1,886 (23.5)	3,012 (37.5)	1,126 (14.0)†	1.99 (1.79–2.22)

Data are n (%). *Group 1: one risk factor without CVDs; group 2: two or more risk factors without CVDs; group 3: presence of at least one CVD; † $P < 00.1$ for follow-up vs. baseline.

tion group and 8,030 (52.3%) belonging to GPs of the control group. Overall, 1,672 patients (22.9%) of the control group and 1,886 (23.5%) of the intervention group received antiplatelet drug treatment at baseline ($P = NS$). When the same analysis was stratified within the different risk groups, the proportion of patients receiving antiplatelet drugs was higher in intervention subgroup 1 ($P < 0.001$) and in control subgroup 3 ($P < 0.05$) (Table 2).

Table 2 also shows the difference in prevalence of high-risk diabetic patients using antiplatelet drugs before and after the intervention. Overall, there was an absolute increase in the number of patients treated with antiplatelet drugs in both groups. However, when the effect of the electronic reminder was evaluated, a clear increase in the number of treated patients at the end of the follow-up (OR 1.99, 95% CI 1.79–2.22) was detected.

Such an effect was particularly relevant among those patients with one (group 1: OR 2.38, 95% CI 1.97–2.87) or more (group 2: 3.22, 2.52–4.12) cardiovascular risk factors but without previous cardiovascular events, rather than in those patients already affected by any CVD (group 3: 1.36, 1.16–1.59).

CONCLUSIONS— The benefit of antiplatelet drugs in secondary prevention is well established (1,2). However, diabetes is also associated with an increased risk of cardiovascular events, even in absence of diagnosed CVD. The recent Adult Treatment Panel III guidelines (12) suggest, in fact, that diabetic patients should be regarded as “coronary equivalent” patients. Moreover, a recent meta-analysis, conducted by the Antithrombotic Trialists’ Collaboration (13)

among 4,961 diabetic patients selected in nine different trials, has estimated that antiplatelet therapy was associated with a 7% proportional risk reduction in serious cardiovascular events.

Our study clearly indicated a low prescription rate for antiplatelet drugs in diabetic patients. Such results have also been confirmed by previous studies conducted in different settings (14,15), where antiplatelet drug rates ranged from 20 to 27% in diabetic patients, compared with 70–80% in postinfarction patients.

The use of specific electronic reminders to improve physicians’ performance at the time of the consultation has been suggested (7). The present study specifically addresses this point. We found a significant effect of the electronic reminder in increasing the number of high-risk diabetic patients prescribed with antiplatelet drugs. A twofold increase was observed when compared with only supplying mailed guidelines and feedback information.

We also found that such a reminder was more effective in patients without any previous CVD. In fact, when patients were subgrouped according to the presence of other risk factors, the groups contributing to the greatest increase in prescriptions of antiplatelet drugs were those without CVD. The latter also significantly increased the prescription rate. Several reasons may contribute to these findings: 1) in the CVD group, multi-therapy is likely to occur, and thus physicians might have decided not to increase the “therapeutic burden;” 2) the proportion of patients who were prescribed antiplatelet drugs was at least three times higher in subgroup 3, and an improvement under these circumstances is rather difficult; and 3) the side effects of anti-

platelet drugs might have precluded further prescriptions.

Results from this study are also important because the integration of the electronic reminder into the standard software was simple and cost-effective. In fact, an upgraded version of this software is constantly sent to >8,000 GPs, and the technical challenges of producing an electronic prompt can be easily overcome without additional costs.

The main problem remains as to whether the electronic reminder would be well accepted by the majority of practicing physicians. James (16) suggested that “to be widely accepted, computerized support systems for decision making must be integrated into the clinical workflow. They might also present the right information, in the right format, at the right time, without requiring any special effort.”

Generally, physicians using computerized software for managing daily clinical practice will more likely accept a computerized decision support system. However, data from our study showed that 128 of 150 GPs truly activated the electronic prompt, indicating that a relevant proportion of physicians did not use the electronic reminder, even if it was made available to them. Such evidence, in addition to the observation that antiplatelet therapy was lacking in >60% of patients even after the intervention, highlights the importance of future research to understand the reasons underlying their choices.

These negative findings are also similar to those reported by Hetlevik et al. (17), who evaluated a computerized decision support system for the management of patients with diabetes in primary care. They found that the guideline was used in

the management of only 12% of patients. Certainly, the implementation of this system cannot be considered the "magic bullet" (18) that provides an answer to all questions, and it must be integrated into further intervention aimed to improve preventive measures in primary care.

Our study has two main limitations. First, the exclusion of GPs who did not reach an optimal level of data quality could have resulted in a selection bias, which could jeopardize the generalizability of the results. Variations in physician characteristics might in fact generally affect several measures related to the process and outcome of health care, including outpatient referrals (19), prescribing patterns (20), and hospital admission rates (21). However, even assuming a 10% relative increase in the effects of the intervention among physicians excluded from the study, there would still be a considerable benefit in terms of the number of prevented cardiovascular events.

Second, the use of repeated prescriptions as a proxy measure for continuing antiplatelet therapy, rather than the assessment of their constant use during the intervention period, might affect the results of the study. However, such a method has been extensively used in several studies (22,23), and it has been validated against medical records and pill counts, suggesting that pharmacy records are closely correlated ($r = 0.92$) with the quantity of prescribed doses consumed (24).

In conclusion, our study provides positive evidence for the effect of an electronic reminder in changing prescriptive behavior among physicians using a standard software system for the management of diabetic patients in their daily clinical practice. Further research is needed to assess whether the effect of such a system is sustained over time and whether it might be effective in different types of patients in the primary care setting.

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