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COMMITTEE⁷

Knowledge and health care resource allocation: CME/CPD course guidelines-based efficacy

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KEY WORDS

Asthma, continuing medical education, continuing professional development, cost, drugs, diagnostic procedures, hospitalization, guidelines, medico-economic assessment, spirometry

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SUMMARY

Background: Most Health Care Systems consider Continuing Medical Education a potential tool to improve quality of care and reduce disease management costs. Its efficacy in general practitioners needs to be further explored. **Objective:** This study assesses the effectiveness of a one-year continuing medical education/continuing professional development course for general practitioners, regarding the improvement in knowledge of ARIA and GINA guidelines and compliance with them in asthma management. **Methods:** Sixty general practitioners, covering 68,146 inhabitants, were randomly allocated to continuing medical education/continuing professional development (five residential events + four short distance-learning refresher courses over one year) or no training. Participants completed a questionnaire after each continuing medical education event; key questions were repeated at least twice. The Local Health Unit prescription database was used to verify prescription habits (diagnostic investigations and pharmacological therapy) and hospitalizations over one year before and after training. **Results:** Fourteen general practitioners (46.7%) reached the cut-off of 50% attendance of the training courses. Knowledge improved significantly after training ($p < 0.001$, correct answers to key questions +13%). Training resulted in pharmaceutical cost containment (trained general practitioners +0.5% vs controls +18.8%) and greater attention to diagnosis and monitoring (increase in spirometry +63.4%, $p < 0.01$). **Conclusion:** This study revealed an encouraging impact of educational events on improvement in general practitioner knowledge of guidelines and daily practice behavioral changes. Long-term studies of large populations are required to assess the effectiveness of education on the behavior of physicians in asthma management, and to establish the best format for educational events.

Introduction

Guidelines are recommendations regarding clinical behavior that help doctors and patients make the best treatment decisions for a particular condition by choosing the most appropriate strategies for specific clinical situations (1). Since the mid-1980s, various national and international guidelines have been developed to address a variety of diseases, including respiratory diseases (2,3); these guidelines are important and suitable tools aimed at making the entire medical process more effective and efficient. However, despite efforts to develop and disseminate evidence-based guidelines, physicians and patients often do not follow them for a number of reasons (4).

Continuing medical education (CME) is a tool designed to improve knowledge and, hopefully, performance. Continuing professional development (CPD) is the educational means for updating, developing, and enhancing how doctors apply the knowledge, skills, and attitudes required in their working lives. Although the CME/CPD systems in European Union member-states differ considerably, CME/CPD is becoming compulsory worldwide due to its potential usefulness in improving standards of care (5,6). Although CME efficacy and cost-effectiveness have been explored (7,8), the ability of a CME/CPD program - in which learning objects are based on scheduled clinical behavior assessment - to improve knowledge and clinical outcomes still needs to be analyzed. This pilot study was designed to assess the effectiveness of a CME/CPD learning program in improving Allergic Rhinitis and its Impact on Asthma (ARIA) and Global Initiatives for Asthma (GINA) guideline knowledge (primary outcome) and adherence to these guidelines in the management of asthma. It is part of the "Respiratory allergic diseases: monitoring study of GINA and ARIA guidelines (ARGA- FARM5JYS5A)" project sponsored by the Italian Medicines Agency within the context of an independent research project (Law 24/11/2003 no. 326 art. 48, item 18, 19. S.O. G.U. no. 274, November 25, 2003).

Materials and methods

Study subjects

A group of 60 out of a total of 650 general practitioners (GPs; 9.2%) were randomly enrolled to participate in this study at the Local Health Unit No. 3 of Genoa. Thirty of

these GPs were randomly allocated to the CME/CPD program, while the other 30 GPs were assigned to the control (no training) group. This study was approved by the Ethics Committee of the Azienda Ospedaliero-Universitaria Pisana and by the Ethical Committee of the ASL (Azienda Sanitaria Locale) n.3 Genovese.

Study design

The educational program was composed of five residential events with four short distance-learning courses between them. The scientific content of the courses was based on the economical analysis of drug prescription and healthcare resource usage data blindly obtained from the database of the Local Health Unit No. 3 of Genoa related to the three months preceding the course. The short distance-learning refresher courses were based on a Learning Content Management System and repeated the concepts imparted during the previous residential course. Participants completed a scientific questionnaire after each CME residential and web-based course (eight and fifteen questions, respectively). Eight key questions (five regarding clinical issues and three regarding economic issues; for example, "At what degree of severity should inhaled steroids be given according to GINA guidelines?") were repeated randomly at least twice in subsequent evaluations.

Method

The Local Health Unit database data were used not only to plan the educational interventions, but also to verify the efficacy of the intervention in terms of physician behavior in asthma management and agreement with GINA/ARIA guidelines. The course content was defined according to GINA and ARIA guidelines and was reviewed by an external board of members of the European Academy of Allergy and Clinical Immunology (EAACI)/CME Committee. The following data related to asthma and rhinitis were obtained from the database of the Local Health Unit No. 3 of Genoa: number of patients receiving medication for bronchial obstructive disorders, number of patients with the right to receive investigations and prescriptions free of charge as carriers of a chronic disease (such as asthma), number of investigations related to asthma diagnoses, prescriptions for asthma (class of drug and expenditures), and the number of emergency room visits and hospitalizations (diagnosis-related group; DRG).

The primary end-point of this study was the change in knowledge, which was assessed with the questionnaires

administered at the end of each course. The secondary end-points were changes in patient management according to data from the Local Health Unit database. A pharmaco-economic assessment of these changes was carried out performing inter/intra-group comparisons and a cost minimization analysis.

Analysis

All GPs who had attended at least 50% of the courses were eligible for inclusion in the analyzed population. Data analyses were performed by a statistician who cooperated with an expert in economics. Friedman analysis of variance (ANOVA) was applied to evaluate improvement in knowledge of guidelines and in answering the eight key questions randomly repeated in the questionnaires. The analysis designed to evaluate changes in disease management was performed using a mixed-effect Poisson model. Assuming that each GP attended the same number of patients, the percentage of the mean variation in the year of observation was calculated compared to the previous year, and in CME participants compared to the control group.

Results

Course questionnaires

Fourteen GPs belonging to the CME group (46.7%) passed the cut-off of 50% course attendance. The analysis of the learning questionnaires completed after each of the five residential courses indicated that the program was able to significantly improve the knowledge of the target population (ANOVA chi-square 18.419; $p < 0.001$). Only 6/14 GPs completed the four refresher distance-learning courses; on average the correct answer rates were 74.4%, 85.6%, 73.3%, and 83.5%. The mean rate of correct answers to the eight key questions increased from 77.4% before the educational intervention to 90.7% after the intervention ($p < 0.03$).

Assessment of impact on healthcare resources - baseline

In 2005, a total of 107,892 patients (6.7% of all patients covered by Local Health Unit No. 3 of Genoa) were given a respiratory drug (ATC R); out of these patients, 81.1% were treated with an R03 drug (drugs for obstructive lung disease). Overall, GPs wrote 325,299 prescriptions for R03 drugs, equivalent to 79.5% of all respiratory prescriptions, for 433,570 packs (76.2% of all prescribed units of respira-

tory drugs). The gross expense related to R03 drugs for the National Health System was €12,359,590.34, accounting for 90.1% of the total expense for respiratory drugs. The most-prescribed pharmacological class was inhaled steroids (9.2% of patients), followed by β_2 -agonists/inhaled steroids (4.7%), β -adrenergic drugs (4.0%), xanthines (0.96%), anticholinergics (0.83%), antileukotrienes (0.70%), and chromones (0.25%). Although many patients were treated with R03 drugs, the number of packs/patient was very low (β_2 -agonists/inhaled steroids, 3.22 canisters/patient; inhaled steroids, 1.84 canisters/patient; leukotriene receptor antagonists, 4.34 packs/patient). In order to obtain more specific data on asthma management, analyses were performed on 7,693 patients (an estimated prevalence of 4% (7) would correspond to an expected 30,457 patients, indicating that we analyzed $\sim 1/4$ of all confirmed asthma patients) with confirmed diagnoses of chronic disease (permission granted by the Local Health Unit to receive investigations and drugs free of charge). Notwithstanding the high number of R03 patients, a limited number of diagnostic investigations was performed: only 14,017 (1/7.7 patients) diagnostic or follow-up spirometries, 2,567 radioallergosorbent tests (RASTs), 6,514 prick tests, 1,281 bronchodilation tests (1/84.2 patients), and 1,463 provocation tests with methacholine. The 2005 admission rate due to obstructive lung disease was high (39.8% of inhabitants).

The 60 GPs included in this study covered 68,146 patients (1 physician: 1,136 patients). A total of 7,834 of their patients were receiving drugs for obstructive lung disease (11.8%), and 709 patients had chronic disease carrier status due to asthma (1.0%). The most commonly prescribed drugs were inhaled steroids (53.8% of patients) and combinations of inhaled steroids and β -adrenergic agents (40.9%), followed by β -adrenergic agents alone (27.4%), anticholinergics (8.2%), xanthines (7.7%), antileukotrienes (6.0%), and chromones (1.3%).

Assessment of impact on healthcare resources - after training

The mixed effects model comparing 2006 and 2007 with regard to diagnostic procedures revealed non-significant decreases in RAST (-25%), spirometry with bronchodilation (-19%), and the methacholine test (-20.6%), but increases in the prick test (11%) and spirometry (0.7%) (Figs. 1, 2). Analysis of the mean percentage difference between the training and control groups uncovered a significant increase in spirometry (+63.4%, $p < 0.01$) in the training group and a non-significant increase in RASTs (+33.6%), prick tests (+31.7%), spirometry with bronchodilation (+46.2%), and

methacholine tests (+66.5%). Among the 14 eligible trained physicians, the proportion of asthmatic patients given inhaled steroids alone diminished by -5.1%, while patients given combination treatment including inhaled steroids increased by 4.7% and patients prescribed antileukotriene compounds diminished by 4.5%. Theophylline usage diminished by 2.5%.

In 2006, 138 patients with chronic asthma carrier status treated by GPs in the training group were prescribed R03 drugs; this number was 149 in 2007 (+7.9%). Considering the patients with chronic asthma carrier status who were treated with bronchodilator + inhaled steroid and were followed by GPs in the training group (92 in 2006 and 111 in 2007), only 15 patients in 2006 (before the educational inter-

vention) and 11 in 2007 underwent spirometry. Among the patients treated with an R03 drug, only 54/138 in 2006 and 45/149 in 2007 were prescribed rescue medication. Of the 10 patients using salmeterol or formoterol, three were not treated with inhaled corticosteroids in 2006; 2/11 patients in 2007 experienced a similar situation. Eleven patients were inappropriately treated with tiotropium in 2006 and in 2007. Regarding expenditure, a comparison of the weighted changes in cost for drugs expressed as percentages between the trained group (n = 14) and the control group (n = 30) demonstrated that the GPs in the training group spent less for all classes of drugs in the year after training (range: -0.11 to -15.8%), with three exceptions in which the increase was minimal (β_2 -long-acting agonists +1.6%, anticholinergics +2.2%, and fixed combinations +3.9%). On the other hand, the control group considerably increased spending for all classes of drugs (range: +7.9 to 47.4%) except for chromones (-28.1%) and theophylline (-10.7%); (Fig. 3). The trend of prescriptions of diagnostic investigations was the opposite: GPs in the training

Figure 1 - Average variation in diagnostic procedure rate after and before intervention (2007 vs 2006)

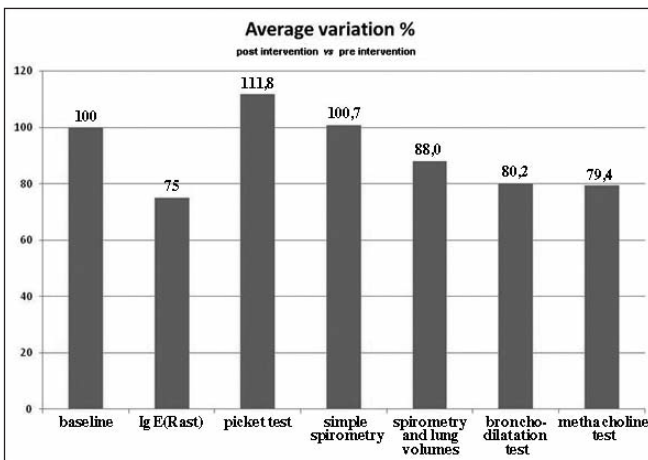


Figure 2 - Average variation in diagnostic procedure before and after intervention in the training vs control group

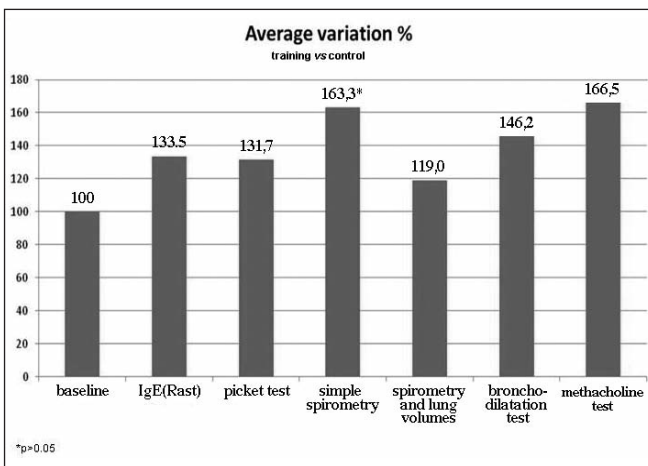


Figure 3 - Change in pharmaceutical expenditure after intervention in training and control groups of general practitioners

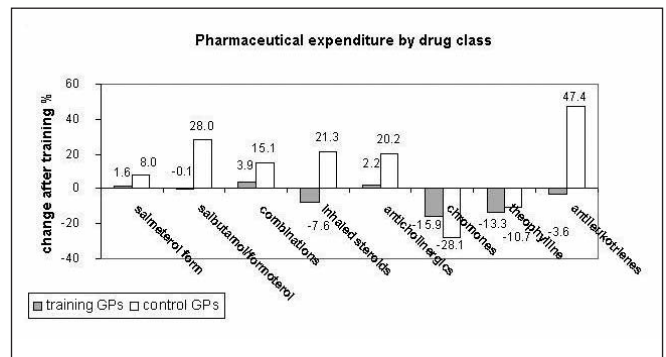
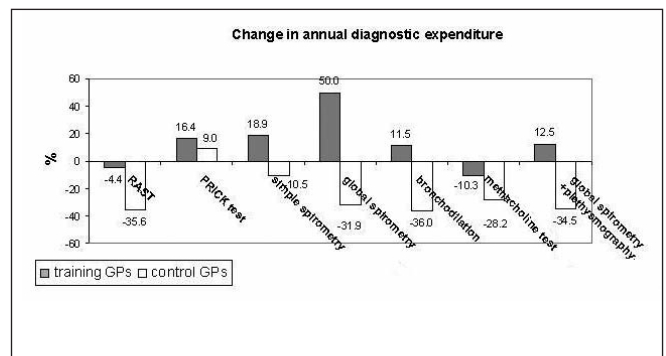


Figure 4 - Change in diagnostic expenditure after intervention in training and control groups of general practitioners



group increased their expenses, especially for spirometry (Fig. 4) and with the exceptions of RAST (-4.3%) and the methacholine test (-10.3%), whereas the control GPs reduced them (range: -10.4 to -36.0%), except for the prick test (+8.9%). On average, between 2006 and 2007 the GPs in the training group spent 0.5% more on drugs (+122.21 euros per GP) and controls spent 18.7% more (equivalent to +3595.04 euros per GP), whereas the GPs in the training group increased spending for diagnostic investigations by 13.4% (+108.85 euros per GP) and the control GPs reduced these costs by 24.4% (-164.14 euros per GP) (Fig. 5).

Mixed-effects analysis of hospitalizations due to asthma with complications (code DRG 096: asthma and bronchitis > 17 years of age with complications) and due to asthma without complications (code DRG 097: asthma and bronchitis > 17 years of age without complications) in 2007 vs 2006 revealed decreases by 28.5% and 8.3%, re-

Figure 5 - Changes in drugs and diagnostic procedure expense (2006 vs 2007) in training and control groups.

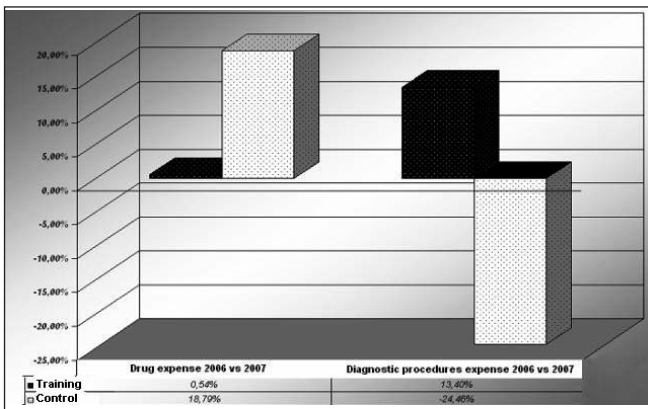
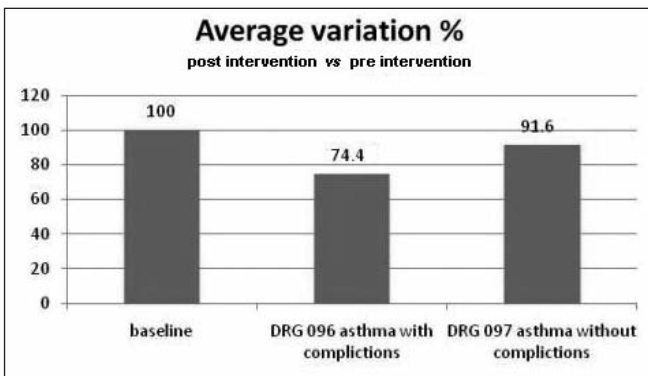


Figure 6 - Variation in hospitalization rate due to asthma with and without complications (2007 vs 2006)



spectively (Fig. 6). Considering DRG 096, an increase was reported in the training vs the control group (+53.0%, not significant), while a decrease in patients admitted

Figure 7 - Variation in asthma hospitalization rate in training vs control groups

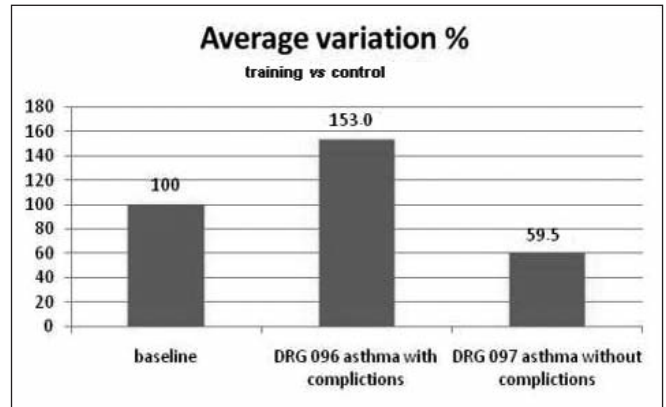


Figure 8 - Variation in hospitalization rate due to asthma with and without complications (2007 vs 2006)

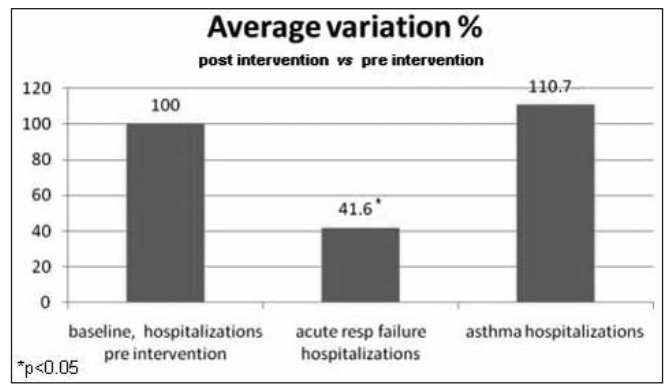
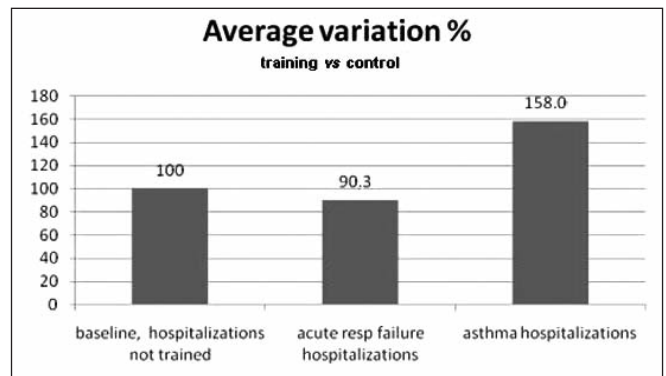


Figure 9 - Variation in hospitalization rate due to asthma with and without complications (2007 vs 2006)



with DRG 097 occurred (-40.4%, not significant) (Fig. 7). Finally, the mixed-effect model showed a significant reduction in patient hospital admission for acute respiratory failure in 2007 vs 2006 in the overall population group (-58.3%) (Fig. 8) and an inter-group decrease in favor of active group, in 2007 (-9.6%) (Fig. 9).

Discussion

The results of this pilot study indicate that the educational program under investigation was successful in terms of improving GP knowledge related to asthma and rhinitis guidelines ($p < 0.001$, +13% related to key topics). However, they also reveal that an educational program lasting one year may be too demanding for GPs; distance-learning was not very successful, as less than half of the GPs in training completed the full year (46.7%) and only six (20%) completed the distance-learning refresher courses, raising concerns about the feasibility of implementing large-scale educational programs for GPs.

The pre-study medico-economic analysis detected a need for training courses in asthma. For instance, many patients received treatment with respiratory drugs associated with high pharmaceutical expenses, but few patients had been assessed by spirometry (1/8) and only 1% had chronic disease carrier status due to asthma (the expected percentage was 4%) (7). Moreover, the number of medication canisters prescribed per patient was so low (2-3 canisters per patient) that it is unlikely that the majority of asthma patients receive any chronic treatment, contrary to guideline recommendations. The medico-economic analysis of this CPD program, in which the educational messages were based on ongoing participant prescription habits and hospitalization analysis, clearly revealed the effects of training, which resulted in pharmaceutical cost containment (+122.21 euros per training-group GP vs +3,595 euros per control GP) and a greater attention to diagnosis and monitoring, as indicated by the increase in expenditure for diagnostic investigations by 108.85 euros in the training group vs a reduction by 163.14 euros in the control group.

Additional positive effects of training were observed in the hospitalization rate trend. In the training group the hospitalization rate of asthmatic patients with complications increased by 53.0% and that of asthmatic patients with no complications diminished by 40.4%, showing that the GPs learned how to triage patients with asthma; this conclusion is also supported by the 9.6% reduction in the hospitalization rate due to acute respiratory failure. These

benefits appeared to be partly offset by the notable increase in hospitalization due to asthma (+58.6%); however, this increase was due to many admittances to day-hospital for investigations, another positive effect of training that induced GPs to improve the work-up of patients with asthma.

The positive outcome of this study, whose methodology is original and applicable worldwide, is consistent with the results of other recent studies on the effects of education on knowledge and confidence of GPs and pediatricians in guideline application (8-10), but it underlines the importance of physician clinical performance analysis in scheduling and modulating the educational interventions. To our knowledge there are no studies on education with a medico-economic outcome such as ours, in which outcomes included not only assessing improvement in knowledge, but also GP behavior from clinical and medical points of view, in compliance with the principles of CPD. These results are encouraging and stress the importance of well-tailored educational interventions. In view of the low participation rate, the pertinent issue becomes the correct format of the interventions. Unlike in the United States, where distance-learning is successful (8), GPs participating in this pilot study did not seem to favor this format, which reduces costs and is less-time consuming for participants. Although the effectiveness of CME/CPD in improving physician performance is debated worldwide, the United States has always acknowledged the need for research addressing the impact of audience characteristics, external factors, and instruction techniques on CME and changes in physician behavior (11-13).

In conclusion, the improvement in GP knowledge of guidelines and consequent behavioral changes following educational events are encouraging. Large-population and long-term studies are required to assess the effectiveness of education on the behavior of physicians in asthma management, and to establish the best format for these educational events.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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