Original Article

WEB-BASED APPLICATIONS FOR GUIDELINE IMPLEMENTATION IN PRIMARY CARE

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SUMMARY

Efforts in developing guidelines have to be supported by investments on their application. Medical software may have a role in these initiatives. Two computer programs have been developed: one regarding chronic kidney disease and one about chronic pain management. For six months their use by 104 general practitioners was monitored. At study conclusion, a questionnaire of 13 multiple choice questions was emailed to all participating doctors. To evaluate the clinical benefits for the patients, a GP regularly used the CKD program and provided patients' outcomes and clinical data. The application recorded 108 accesses during 66 work sessions. In the clinical outcomes section of this study, 7 patients out of 21 were diagnosed with CKD. Our study shows a need for programs of the "expert systems" kind: sources devoted to a narrow field of competence, accessed only when needed, in a way that resembles traditional specialist consultation.

Introduction

The technological innovations of recent years have changed medicine in a way comparable to the introduction of the stethoscope in 1800. [1] Modern medicine, based on scientific evidence, is founded on the results of research and clinical trials. The best clinical practice, following the latest discoveries, is informed by guidelines which are continuously revised. Therefore, doctors are required to continually keep themselves up to date. The introduction of personal computers and internet access has made keeping up to date professionally significantly easier and has made almost unlimited resources available. [2,3] However the mere possibility of accessing the most updated guidelines may not be enough to guarantee quality care. Recent studies have shown that efforts in developing guidelines have to be supported by investments in their application, for example "pay per performance" initiatives, identifying successful practice implementation examples or providing technical assistance for implementation. [4,5] Medical software based on guideline algorithms, which allow the clinician to apply them step by step, even without a specific competence in the field, may have a role in these initiatives.

The aim of this study is to verify the impact of Web-based Applications, developed to facilitate the implementation of Primary Care guidelines, on the daily work of the General Practitioner.

Methods

Two computer programs have been developed: one regarding chronic kidney disease (CKD) and one involving chronic pain management (CPM). These topics are of current interest in Italian Family Medicine. The first program was designed to be used constantly, due to the need to enter data and monitor changes over time. The second program was

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only expected to be used "on demand". To estimate access due to curiosity, a link to an empty program, primarily regarding hypertension, was also provided. Subsequently, 104 general practitioners (GPs), working in the area of Milan and province, were contacted by email, granting them access to the programs' website. For six months (from April to September 2011) its use was monitored by access statistics, generated by both programs and the site. At study conclusion, a questionnaire of 13 multiple choice questions was emailed to all participating doctors. To evaluate the actual clinical benefits for the patients, a separate sub-study was conducted. A GP, responsible for 1500 patients at Barlassina, a town of 5000 people in Lombardy, agreed to regularly use the CKD program and to provide patients' outcomes and clinical data.

The programs
The programs were designed to be as simple and as quick to use as possible. Consequently, the manual data input and the "number of clicks" needed to get to the conclusion of the algorithm were minimal. The interface was designed to be as easy and clear as possible. We looked for a free solution that did not require installation and could be accessed from every platform. So we decided to create a Java "Web-based Application". In this way, the GP only had to connect to the homepage of our project (http://progettommg.altervista.org) and open the link to the programs, which run directly in a web browser window. The Web Application is structured as a computer desktop in which the windows of the individual programs are opened. Upon opening, a security dialog appears; without permission some features are not activated, such as the ability to save patient data on a user desktop. Also the registration of access statistics depended on the user's consent.

Chronic kidney disease
The program implements the NICE algorithms on chronic renal failure.[6,7] The clinician chooses the main chronic diseases of the patient from a drop-down menu ,which may or may not justify further investigation. Then, he or she can calculate GFR using the MDRD method and also calculate the albumin/creatinine ratio, or input them directly if available. The user may continue with the proper NICE algo-

rithm through a series of pull-down menus. The program then gives a clinical response and may suggest a treatment, specialist consultation or a follow-up program. In the latter case, it is possible to save patient data in order to use it later to calculate the progression of glomerular damage, as measured by filtrate reduction within the year. During follow-up visits, depending on the result, the program indicates whether the patients' illness is stable or whether it is appropriate to refer to a specialist.

Chronic pain management
The program is divided into three sections. In the first section, several guidelines on chronic non-neoplastic pain treatment are implemented.[8-13] The clinician selects a patient's disease and the program provides the first, second and third line of therapy, showing dosage and pharmacological characteristics of the active ingredients, as well as a link to the drug's data sheet. In the second section, WHO guidelines for treatment of cancer pain are implemented: the program provides a Visual Analog Scale that the patient uses to express pain severity.[14,15] Depending on the score, one of the three steps of the WHO ladder is suggested: use of NSAIDs alone or in combination with weak or strong opioids. For each of them, the program suggests methods of administration and dosage, and provides a link to the data sheet of the drug. In the third section, concerning the management of chronic opioid therapy, the program offers calculators for titration of morphine, conversion to extended-release preparations, management of side effects and opioid rotation.[16-21]

Results
Statistics of access
At the end of the six month period, the site recorded 95 hits from 79 different IP addresses (76% of the initial sample of 104 GPs). According to data from the site (which records the "public" IP), at least 7 users accessed the program more than once (range 2-7). At the same time, the application recorded 194 events. Of these, 108 were accesses to one of the programs, 66 exits from main application; indicating the end of a work session and 20 exits without a corresponding access; suggesting a technical problem or a user drop-out (Table 1). According to data from the application, an average of 1.6 programs per

work session were used and a maximum of 23 users accessed the programs more than once according to "private" IP recording. In the first month (April), the highest number of accesses (44.8% of total) was recorded, while July and August showed the least number of accesses, 2 and 4% respectively. The program regarding CKD was the most widely used with 83 events, followed by the 3 programs on pain management (78 events total); accesses to the empty page involving hypertension were only 13, most of which (8) took place during the first month (Figure 1).

Clinical outcomes from CKD program implementation

Over six months, 24 visits for 21 patients were recorded. The primary risk factors for which the screening algorithm was used was diabetes for 12 patients and hypertension in 9 cases. Following indications of the algorithm, two hypertensive and one diabetic patient were examined a second time. Renal function was compatible with CKD stage 1 or 2, without renal damage, in 13 visits. In 7 visits the result was stage 3A or 3B CKD, in one case it was stage 4. Two patients in stage 3A and one in stage 4 had a follow-up visit. From an operational point of view, the algorithm suggested a yearly routine check-up in 10 cases, early initiation of antihypertensive therapy with ACE inhibitors in 4, the repetition of GFR determination and a follow-up visit in order to assess the possibility of kidney damage progression, in 6 cases. For only one patient was a specialist referral directly suggested. The 3 follow-up visits showed one stabilization and two aggravations. None

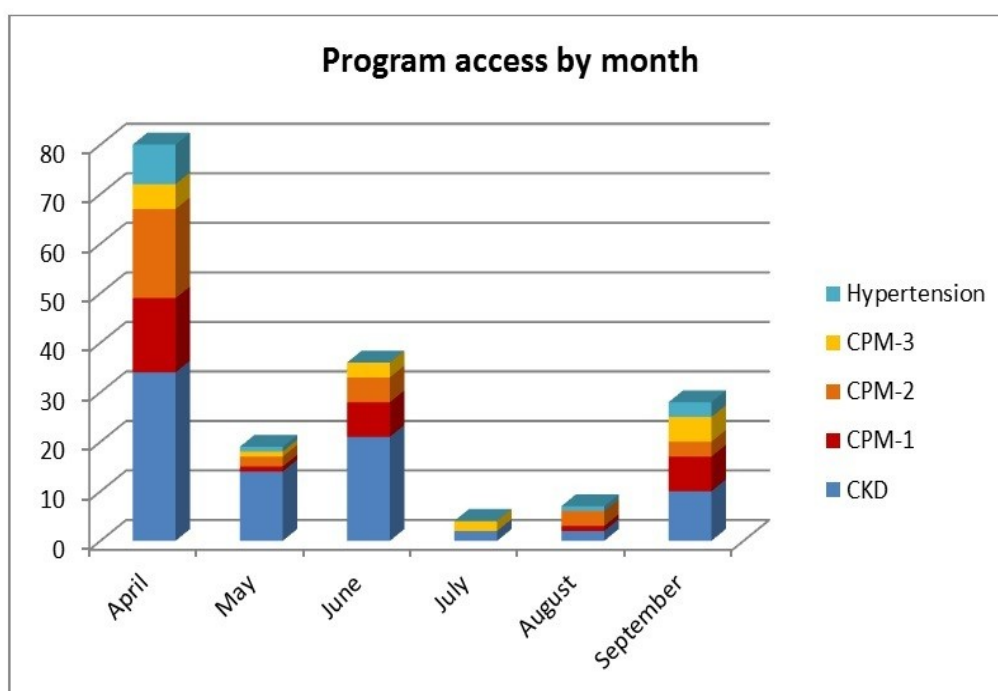|	CKD	CPM-1	CPM-2	CPM-3	Hypertension	Total
Accesses	46	22	17	10	13	108
Exits (work sessions)	37	9	14	6	0	66
CKD: Chronic kidney Disease CPM: Chronic Pain Management						

Table 1: Application-recorded events.

Figure 1: program access by month.

of the patients were known to have kidney disease.

Questionnaire

We received 8 fully compiled multiple-choice questionnaires (7.7% of the 104 GPs invited). One half of them report having used the CKD program, the other half reported having used the program on CPM. Technical problems were reported in 25% of the cases, problems ranged from the unavailability of Internet access to a difficult Java update procedure. Only one doctor reported that the programs required the reading of the manual provided on the website to understand their use. Three users reported that computer programs, as a rule, require too much time. All GPs reported that programs are helpful in daily clinical work. With only one exception, participants felt that these programs should only be used for selected cases as they can improve, but not replace, professional updating. They felt that in time this kind of program would become essential for the profession. All participants would have appreciated a version of the program which was integrated with their practice management software. Fifty percent of them would also have used a "portable" version, capable of functioning also at a patient's home, for example on smartphones.

Discussion

Italian GPs have to use a computer and an internet connection because the regional health system requires electronic transmission of prescriptions. In Lombardy, over 95% of them use health record (HR) software. Some HR programs also implement advanced functions, such as the automated calculation of glomerular filtration rate upon input of creatinine values or specific anamnestic tabs for pain evaluation, as in Millewin developed by Dedalus or DFD by effepieffe srl. However, since these are only information tools, lacking evidence-based information on how to best apply medical knowledge, they are only partial tools used to align clinical decision-making with best practice guidelines. The programs that we created supply the clinician also with point of care therapeutical and gestional algorithms. The questionnaire results confirm that they reached a sufficient level of "user-friendliness", which represented one of the

main features of our project. Programs are cost-free and technical difficulties appear to be quite limited. The problems reported in questionnaires were related to technology issues which are not relevant to the structure of the application. The sum of these factors explains the considerable interest aroused by our research, indeed, 76% of invited doctors accessed the website. After a peak in the first month, we recorded an average use of 30 events per month. From this finding and from recorded data on repeated accesses by the same user (albeit of limited reliability: depending on the recording technology from 7 to 23) we can say that approximately 15% of physicians have routinely used the programs for their own clinical activity. This is confirmed by the fact that, after the first month, there were only 5 hits to the "empty program" on hypertension: this indicates that accesses were in response to a specific need and not out of curiosity. Long-term use was relatively low compared to high initial interest. The most feasible explanation is that the use of such programs, although designed to be as simple as possible, is still time consuming, especially due to data entry. Questionnaire results support this theory. More specifically, programs have been used only on selected patients and an integration with Practice HR software is deemed useful, since an integrated program would allow automated data retrieval and input. Even the doctor who participated in the CKD clinical outcomes section of this study reported that all patient data was first collected on the Practice management software and then all successively entered in one single session. This study presents several limitations, mainly related to the small number of questionnaires returned and to the single GP participation in the CKD clinical outcomes section. Further investigation is needed to increase data significance. This goal could be achieved by involving GPs from all over Lombardy, since there are no added costs in increasing the number of participants. However, even within our limited data, the programs were shown to improve the quality of patient care, for example by enabling an early diagnosis not otherwise achievable: 7 patients diagnosed with stage 3A-3B CKD were not previously known to have this disease.

In conclusion, the General Practitioner, due to the nature of his job, regularly faces multiple problems belonging to very different medical fields. Therefore, being constantly up to date on the latest available clinical evidence is hardly feasible, especially for uncommon topics (for instance advanced oncologic pain management). Our study shows a need for programs of the "expert systems" kind: sources devoted to a narrow field of competence, accessed only when needed, in a way that resembles traditional specialist consultation. Medical software appears to be useful also for offering advanced computing capabilities, allowing an easy use of complex formulas such as MDRD. In selected cases it may also simplify the recording of patient clinical-numerical data and their assessment in the long-term. We may therefore conclude that the diffusion and use of medical software for guideline implementation improves quality of care.

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