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Synopsis

Health and Clinical Management

This section of the Yearbook contains four articles [1,3,7,9] which have been selected for their specific approaches in using medical informatics methods or applications as promising tools to enable new types of research in health and clinical management. The common features of these papers are that three of them appeared in journals other than those specialized in medical informatics, and that they show new ways of dealing with clinical or epidemiological research studies. Another feature is that they use a wide range of information technology methods, from Web technology to GPS (Global Positioning Systems) , quality assessment to computer-aided diagnosis. In these papers, information and communication technologies have been used as tools for clinical or epidemiological studies based on new methods. The studies were conducted in various fields including quality of life research, clinical quality insurance, geographic information systems for epidemiology, and assessment of diagnostic interpretation of electrocardiograms. All these papers are "population oriented" in that they consider the use of new technology to improve quality of care or prevention.

The paper by Soetikno et al. [1] deals with quality of life research on the Internet and addresses the problem of replacing or complementing the classical approach of conducting epidemiological research by using new tools available on the World Wide Web (WWW). The paper deals with the questions of the feasibility and validity of such an approach in patients with a specific chronic disease, namely ulcerative colitis. Of course, the prerequisite of such a study is that the Web has sufficient coverage in the general population, which seems to be the case in North America, where the authors conducted their investigation; at the time of the experiment in early 1996, Internet was already used by more than 13% of the US population. Another experiment, conducted in 1996 by Bell and Kahn [2], successfully used the Web for assessment of health status. Another important issue is that patients using the Web tools may differ from those in the community at large, because such research relies upon self-selected patient volunteers who must have incentives that motivate their search for information dealing with their health status.

Therefore, the method used by the authors had to test the feasibility of performing quality of life surveys in a specified patient population using the Web and compare the health status of volunteer patients recruited from the Web community with volunteer patients recruited from a specific clinic for ulcerative colitis. The clinical background for this chronic disease is for young adult patients to decide whether to accept an increasing risk of colon cancer as well as relapsed of the disease, or to undergo surgery: colotomy with ileal pouch-anal anastomosis (CIPAA). Because such surgery is not frequently performed, using the Web technology, the authors attempted to locate such a population of patients who had undergone this surgical procedure. Then they compared these latter patients with a modestly sized group of similar patients recruited from a surgical clinic in the San Francisco Bay area.

To meet these objectives, a Web server was set up with a small database connected by a CGI (Common Gateway Interface) implementation; a procedure was approved by the Stanford University Non-medical Human Subject Committee to obtain informed consent from patients, prior to their participation in the survey. The survey first collected contact and demographic information before requiring completion of on-line questionnaires: the SF-36 Health Assessment Questionnaire and the Self Administered Inflammatory Bowel Disease Questionnaire (IBDQ). Then the patients' preferences for their present health status were assessed using an interactive visual analog scale (VAS) and Standard Reference Gamble. The last part of the survey was a multimedia description of the effects of CIPAA surgery on quality of life. The Web system was designed such that the patients could fill in part of the questionnaires and resume the data entry at a later date.The recruitment of patients was done using the reference of the Web site of the Crohn's Colitis Foundation of America and the indexation of five major Internet search engines. The Web group of 53 patients was selected from several states of the USA and other developed English-

speaking countries (UK, Canada, Australia) and compared to a group of 47 patients selected from the clinic.

The results were analyzed using classical statistical methods and they show that the surgically treated patients selected on the Web were younger than the patients who were followed by the clinic, had a lower health status according to the SF-36 questionnaire and also had a lower score on the IBDQ. Besides these results, this paper has an interesting discussion which confirms that it is possible to use new tools, such as the Web, to recruit volunteers for epidemiological research on quality of life in relation to specific chronic diseases. Some explanations about the systematic differences between the two populations are given: first, the patients in better health may not bother to enroll in a survey on the Web; second, the unwell patients were not ready to attend the clinic for a classical survey. In a former study by Bell and Kahn [2], the health status of a general Internet population showed that according to the SF-36 score, the population was in better health. The authors consider that the link between disease level and information-seeking behavior in patients needs to be explored in greater detail in future research; consequently, they conclude that the use of Internet for such surveys may be more generalizable than classical surveys conducted in a medical setting. They also think that the Web may be a more cost-effective tool for performing longitudinal studies of quality of life. Finally, they also propose that the Web be used for randomized trials for non-pharmacological strategies for disease management.

This work is certainly a breakthrough in the direction of new methods and tools for recruiting and analysis of epidemiological studies investigating quality of life. However, it must be followed by further studies on the psychological behavior of patients with regard to their willingness to participate in such surveys. Besides that, cultural and economic differences between populations, even in the same country, must be assessed .

The second paper by Petersen et al. [3] also deals with quality measurement and improvement in health care, using computer methods and tools. The topic addressed in this paper is that many medical injuries may be preventable, but few successful strategies for prevention are reported .

Epidemiological studies in the USA [4] show that each year 100,000 preventable deaths result from medical injury. A previous study [5] showed that discontinuity of house staff cross-coverage was an important risk factor for preventable inpatient adverse events. The work presented here aimed at using industrial quality insurance methods to develop interventions intended to reduce rates of medical injury, and to evaluate its effectiveness by using a self-report methodology [6]. The intervention was designed by the house staff that felt that a computerized sign-out program was the best solution. The specifications of a program connected to the hospital information system were designed by the house staff. The program includes a summary of the patient's current medical status, resuscitation status, recent laboratory values, allergies, a problem list, and a "to do list" for the treating physician. This information was accessible from any hospital computer and workstations were located in every inpatient unit. During the study, the house staff physicians on each clinical team received by e-mail daily reminders for reporting adverse events. An adverse event was defined as an injury due to medical therapy which prolonged hospital stay or resulted in disability at discharge.

The resident completed a standardized data form and an Acute Physiology and Chronic Health Evaluation II (APACHE II) data form for the reported case and for two control patients located in beds on either side of the case at the time of the event. A panel of three Board-certified internists confirmed events and evaluated preventability based on case summaries. The results show that after the intervention, in a population of 3,747 patients, the rate of preventable adverse events decreased from 1.7% to 1.2%. Univariate and multivariate statistical analysis showed no association between cross-coverage and preventable adverse effects after the intervention. The odds ratio for a patient suffering from a preventable adverse effect event during cross-coverage was no longer significant after the intervention.

In the discussion, the authors emphasize the importance of continuity of care to prevent adverse effects. Use of the computerized sign-out in 88% of eligible patients drastically reduced the preventable adverse effects due to the discontinuity of care. This is certainly due to the fact that computerized intervention is more effective and more efficient than relying on education, memory or behavioral changes. It is interesting to stress that this approach to prevent iatrogenic problems using a system-wide approach is the basis of efficient continuous quality insurance. Although this work was done before the Joint Commission on Accreditation of Healthcare Organization defined a sentinel event policy, it will certainly help the quality insurance committee of the hospital to analyze the roots of the medical errors and report such events if necessary.

The third paper by Hightower et al. [7], describes the use of new methods and technologies to get precise maps of tropical zones where existing geographic maps are either not available, inaccurate or inaccessible for epidemiological studies. A collaborative study of the natural immunity to malaria in western Kenya started be-

tween the Kenya Medical Research Institute and the Centers for Disease Control and provided the framework for this work. Epidemiological studies of infectious diseases, such as malaria, on a given cohort, require precise geographic analysis of the region and spatial relations with the environment of human populations who live in the rural regions. A GPS [8] apparatus was, therefore, necessary to provide accurate and detailed maps of a 70 km² region.

The paper describes the GPS methods and the possible errors encountered in a single reading of the standard GPS unit. Therefore, a differential GPS (DGPS) method using two GPS units was necessary. One unit is located at a fixed control site (preferably at a known location) and the other is a mobile field unit. The matching files are then downloaded on a computer and appropriate software is used to pair and synchronize the readings taken at the same time. With this method, the errors can be reduced to a range of 2-5 meters on the horizontal axis and to 3-7 meters on vertically. Linear geographic features such as roads, rivers, and shores may also be obtained with mobile differential positioning. The data are then transferred in a Geographic Information System to create multilayered maps for, e.g.: households, mosquito sites, roads, streams, lake shores, hospitals, clinics, shops, etc. Each household located on the map can be linked to a database containing data on entomologic, meteorologic, epidemiologic, demographic, immunologic, and parasitologic information. Quality assessment in terms of accuracy and completeness was made to check the obtained maps of the 15 existing villages in the area. The results relate parasitemia prevalence and entomologic measures to the distance from the households.

The discussion confirms that it is feasible to use DGPS for highly accurate maps of households and other points of interest, as well as linear geographic features. Furthermore, training the field staff to use DGPS was easy because the use of these new technologies created enthusiastic participation of the staff. Recent improvement of the GPS technologies will make it easier and faster for further work on building precise maps. The analytic phase of the project is in progress to link the base map with various longitudinal data sets. This work shows that the combination of spatial communication and computer software gives a powerful tool for spatial epidemiological analysis in any environment. The use of a Geographic Information System will enable epidemiologic researchers to investigate new spatial effects for specific disease studies.

The final paper, by De Bruyne et al. [9], deals with the performance of computer programs for diagnostic interpretation of electrocardiograms (ECG) in population-based research. To reduce the time spent by cardiologists for interpretation of ECG in such studies, alternatives are to use research physicians or a computer ECG analysis program. The advantages of the latter solution are that the inter- and intraobserver variability in interpretation and coding is reduced and it is cost effective by reducing the time spent by physicians.

The primary objective of the study was to assess the performance of diagnostic ECG interpretation by the computer program Modular ECG Analysis System (MEANS) developed by the authors [10]. The second objective was to establish a strategy for ECG interpretation in health surveys. Three scenarios were compared: one using the computer program alone (a); a second (b) by computer program where positive findings were checked by a cardiologist; and a third (c) where all ECGs were interpreted independently by the program and a research physician, and those ECGs on which they disagreed were interpreted by a cardiologist. The ECGs used were sampled from the Rotterdam Study in the Elderly and were enriched by abnormal ECGs and ECGs on which the MEANS program and the research physician disagreed. Then a stratified sample was made containing 50 ECGs with agreement on the presence of abnormality, 100 ECGs with agreement on the absence of abnormality, 200 ECGs with major disagreement and 50 ECGs with minor disagreement. Five diagnoses were considered: Anterior Myocardial Infarction (AMI), Inferior Myocardial Infarction (IMI), left ventricular hypertrophy (LVH), left bundle branch block (LBBB) and right bundle branch block (RBBB). The final data set contained 381 ECGs used for the assessment study. In the study, the reference was the reference cardiologists. Therefore, the performance of the MEANS program and research physician can never be better than the reference.

The results show that the sensitivity and specificity of the MEANS program and the research physician were high. Regarding the scenarios, scenario (a) is satisfactory only for LVH, RBBB and, LBBB diagnoses. Scenario (b), in which all positive results of the MEANS program are verified by a cardiologist, is the best procedure for all ECG diagnoses to identify cases with an ECG abnormality but it underestimates the prevalence of such abnormalities. Scenario (c) provides the best estimates of prevalence and has the highest proportion of correctly classified controls but has the highest costs. In the discussion it is proposed that for population-based research the MEANS program can be used with scenario (a) (without human readers), while scenario (b) could be used for positive findings of AMI and IMI controlled by cardiologists. Therefore, it is a good compromise to keep the workload of human readers to a minimum, while giving reasonable estimates

of prevalence of ECG abnormalities and classification of cases. In conclusion, this work shows that diagnostic ECG interpretation by a computer program can be very helpful in population-based research. It is at least as good as the interpretation of trained research physicians but more efficient and less expensive. In this proposition, the cardiologists are used as experts only for difficult cases of specific diagnoses such as myocardial infarction.

When overviewing this year's selection of papers in the section Health and Clinical Management it is important to note that the use of medical informatics and communication methods are really used or proposed to modify the way the clinician and/or epidemiologist may conduct population-based studies. In all cases it is clear that the traditional methods used for data collection were either not applicable or too costly to be efficient. This trend will probably be seen in the near future because the increased combination of digital communication networks (which are now integrated all over the world) with the ubiquitous microcomputer technology is becoming effective everywhere, with a minimal cost. This is true not only for developed countries but is also applicable to developing countries as the availability of such tools may now be reasonable and cost effective for epidemiologic research in tropical regions. The experience described by Hightower and colleagues [7] shows that these innovations can be used for geographically precise epidemiological research studies. In the developed countries the use of Web technology is still to be explored and validated in the population at large, but the first studies conducted in the USA are promising for quality of life and clinical or health follow-up studies [1,2]. Inside the health institutions (hospital information systems and/or health information systems) the use of communication networks and computer technology is, of course, making progress both as a tool for quality insurance enforcement to reduce iatrogenic effects as shown by Petersen and co-workers [3] and as a diagnosis aid for ECG interpretation in population-based studies as was shown by De Bruyne and colleagues [9]. Finally, we can say that these papers show that communication and medical informatics innovations are really promising in the field of clinical and health management.

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