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A Computerised Guideline for Pressure Ulcer Prevention

Silvana QUAGLINI*, Manuela GRANDI**, Paola BAIARDI**, M.Cristina MAZZOLENI**, Clara FASSINO*, Giorgio FRANCHI**, Stefania MELINO**
**Dipartimento di Informatica e Sistemistica, Università di Pavia*
***IRCCS Fondazione "S. Maugeri", Clin. del Lavoro e della Riabilitazione, Pavia, Italy*

Abstract. This work illustrates the implementation of a computerised guideline for the pressure ulcers prevention. In particular, we describe the site-specification of a guideline delivered by the Agency for Health Care Policy Research, its integration with the electronic patient record, and its introduction within the clinical routine. The system facilitates trained nurses in the patient management by producing daily work-plans, and novice nurses by running as an educational tool.

1. Introduction

Despite the great emphasis that medical communities put on clinical practice guidelines (GLs) during last years, several problems are associated with diffusion and implementation in clinical setting: "official" GLs often do not fit the organisational constraints, health care operators often do not fully comply with GLs, and physicians rarely are provided with instruments for evaluating the benefits of a GL introduction, in such a way to be convinced by the evidence of improved outcomes. Information technology may help to overcome these difficulties. Formalisms for computerized GL representation have been developed [1,2], and connection of the GL with the electronic patient record has been shown to enhance compliance. Very important, different inference engines may be applied to the same GL in order to achieve a user interaction tailored to the specific clinical setting. As for any other information tool or decision support system, it is very important that the GL do not badly interfere with the clinical routine. Thus, we focussed our attention on the GL/user interaction, and we distinguished three key aspects:
- The *advice production*: it can be "explicit", i.e. the GL suggests actions in real time (suitable for beginners), or it can be "silent", i.e. the user is advised only when a non-compliance is detected (worth for expert users).
- The *compliance*: the GL proceed to the next task(s) only if the user fully complied with it concerning the previous tasks; or the GL proceeds also in case of non compliance, but only if the user provides a justification for that; finally the GL proceeds in any case, storing the non-compliance in a silent mode.
- The *intervention time*: the GL reacts in real time to the users actions: this implies the possibility of interacting very frequently with the computer and thus assumes the existence of a very efficient and distributed information system; on the contrary, the user could access the GL only in specific time slices.
In this work, we illustrate the implementation of a GL for the prevention of pressure ulcers, and motivate our design choices according to the framework illustrated above.

Pressure ulcers are defined as any lesion caused by unrelieved pressure that results in damage to underlying tissue. They are serious problems that can lead to pain, a longer hospital stay, a lower recovery, and additional pharmacological treatment, all factors affecting both quality of life of the patients and economic costs. Pressure ulcers prevalence surveys point out percentages from 9.2% to 47% [3,4]. Prevention plays an essential role: risk evaluation and preventive care plan are needed since the first days of hospitalisation. In fact about 50% of pressure ulcers occurring during the stay appear within the first week. Nurses, who are traditionally sensitive to this problem, often lack of precise and standardised procedure to approach it. The Agency for the Health Care Policy Research (AHCPR) [5] delivered a GL for the pressure ulcers prevention, that has been the starting point for our study, as well as for past implementation [6].

2. The site-specification of the GL

The AHCPR recommendations were tailored according to the proposal of both the Italian Nurse Association for the Study of Cutaneous Lesions and our hospital physicians and nurses [7], in order to make GL usable on all the hospitalized patients with efforts and resources maintained within acceptable limits. Site specifications concern risk assessment and actions to be taken. In particular: age over 65 was locally considered sufficient to include the patient into at risk population (absent in the AHCPR GL); nutritional deficit is inspected through different variables; some predisposing pathologies together with the presence of an existing pressure ulcer are included in the evaluation of risk; the frequent (every two hours) reposition of the patient proposed by AHCPR with strength of evidence=B (high) was not accepted due to excessive induced overburden for nurses; skin evaluation every two days, instead of once a day; finally, more details are provided on medications to be used in order to reduce friction injures.

3. The GL formal representation

Figures 1 shows the site-specified GL through a graphical editor [6], that allows to represent GLs at different hierarchical levels. The editor, written in Java, produces an internal representation of the GL in terms of relational tables and is associated to an inference engine that generates advises according to the stored patient data. It is very useful for educational purposes, because the user can simulate patients and obtain suggestions in real time. Graphical facilities have been designed such as different colours indicating different task states and different bullets indicating levels of scientific evidence supporting that task: red for a *strongly recommended* task, yellow for a *recommended* task and green for a *suggested* task. Pointers to literature may be associated to bullets as a GL documentation.

4. The functional architecture

As mentioned above, the GL implementation took into great account possible bad interference with daily work. Figure 2 shows the system functionality. At the beginning of their shift, nurses ask for a printing of the workplan for the day. The workplan is produced by the GL inference engine, according to the GL rules, fired with data stored in the EPR. At the end of their shift, nurses store data about the executed workplan, using the same interface they are using since many years for the HIS. Of course nurses adopting the GL are not the only users accessing the EPR. Additional information is stored also by physicians and laboratorists. The difference lie in the fact that nurses *must* fill the EPR, because the GL will not produce the next day workplan if the previous one has not been discharged. Also

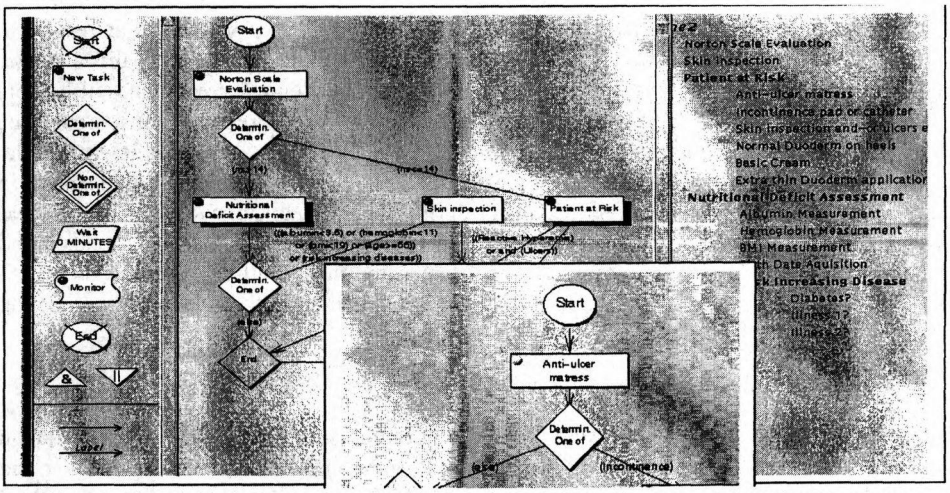

Figure 1- The graphical GL representation: shadowed rectangles indicate composite tasks. The pop-up window is a scratch of the expansion of the "patient at risk" task

storing the non-compliance is mandatory, in order to continue with next workplans: if some of the suggested actions have not been performed, nurses must give a justification, and the same actions will be suggested again the day after.

A scratch of a printed workplan is shown in Table II (bold items are filled by nurses). The interaction with the system is then at specific time slices, at the beginning and at the end of the daily work. All day long, nurses annotates information on the paper workplan. This has been considered as the optimal system/user interaction in our environment, because a real time storing of data about actions performed on the patient is impossible for logistic reasons.

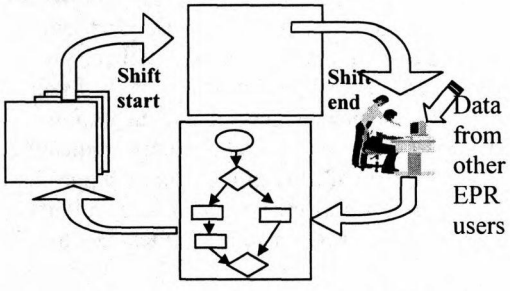

Figure 2 – The system-user interaction

5. The interaction with the EPR

Figure 3 shows the compilation of the ulcer risk assessment form. This task is mandatory for every patient admitted to the ward. Weight and height data, as well as information about diseases that increase the ulcer risk, are retrieved from the EPR, because this form is filled after objective examination and anamnesis. Other fields, namely the Norton scale and the feeding type, are filled by the nurses. The GL *imposes* the compilation of this form at pre-defined time intervals, that vary according to the patient condition. As a matter of fact, to each item stored in the EPR, a time stamp is associated, that is compared with the *persistence* time stored in the GL. Figure 4 shows the form that nurses fill at the end of their shift. It is a copy of the workplan that they should have used during the day. The pop-up window illustrates the input of the motivation of a non compliance.

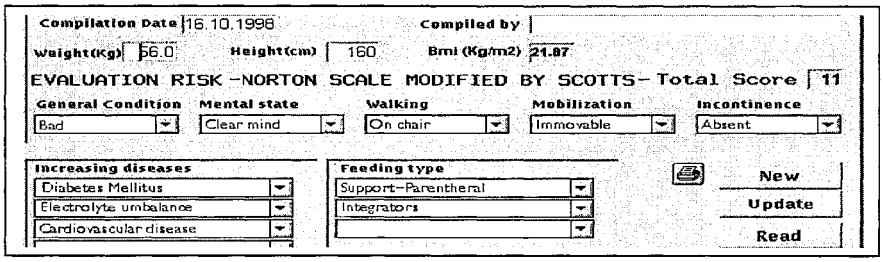

Figure 3 – Filling the form for the patient risk evaluation

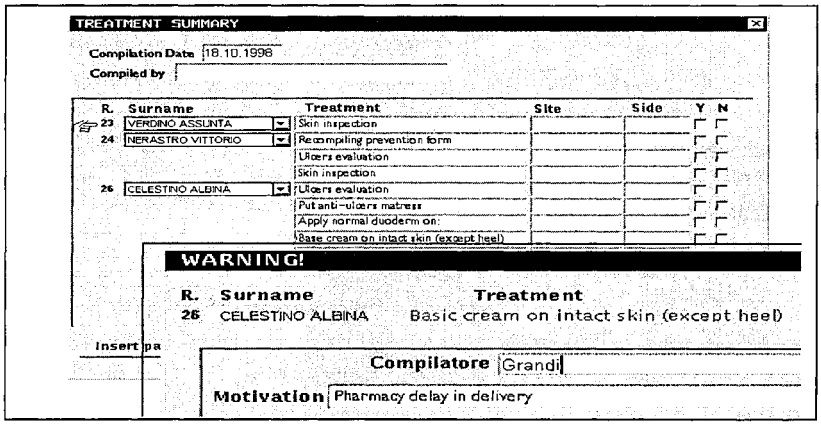

Figure 4 – Filling the workplan at the end of the shift: non-compliance must be justified

6. Conclusion and future development

We have designed and implemented a decision support system for the pressure ulcer prevention, integrating it into the existing electronic patient record of a general medicine ward. During next months data will be collected with two aims: to evaluate the user satisfaction and to evaluate the benefits of the GL introduction on patient outcomes. Comparisons with previous ulcer incidence in the same ward and with other wards where the GL has not been adopted will be performed. Data about non-compliance will be used as a feedback for improving the GL implementation.

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