Measuring the Frailty Index of Multiple Myeloma Cancer Patients

Andrea Corradini

Design School Kolding
Aagade 10, 6000 Kolding,
Denmark
andrea@dskd.dk

Martin Bøgelund Hansen

IT University of Copenhagen
Rued Langgaards Vej 7, 2300
Copenhagen, Denmark
marha@itu.dk

Toma Savic

University of Southern Denmark
Universitetsparken 1, 6000
Kolding, Denmark
tosav@sdu.dk

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Abstract

We report on a responsive web-based application that we have been developing for the cancer hospital in Vejle, Denmark. The application administers and handles systematic frailty scoring of patients with multiple myeloma and helps doctors make a more efficient and effective treatment choice. The application is currently being tested with a small number of patients and is to replace the frailty measurement system used until now, which is done by the doctor on a per patient basis.

Author Keywords

Web application; mobile health; frailty scoring.

ACM Classification Keywords

H.1.2. User/Machine Systems: Human information processing; H.4.1. Types of systems: Decision support (e.g., MIS); H.5.3 Group and Organization Interfaces: Web-based interaction.

Introduction

Over the last years, cancer therapy has improved and become more complex. Beside surgery, chemotherapy, radiotherapy, and hormonal therapy, newer targeted treatments are now available. While standardized, most of these antineoplastic treatments are still potentially toxic. In Denmark, each type of cancer requires a particular combination of treatments and protocols that

Our Application and the Patient's Electronic Health Record (EHR)

The hospital in Vejle uses Cambio COSMIC as EHR (<http://www.cambiohealthcare.co.uk/Cosmic/>). It only allows including certain file types to each patient's record. Because of that, instead of running our application from inside COSMIC, doctors use a standalone version of it. After determining the frailty score for a patient (the patient is validated using its identification number, called CPR number), a report in PDF format is created and then pipelined to an external application, called onBase, that makes it possible to add documents to the EHR. When a doctor wishes to look up a patient's frailty score, s/he can access the patient's EHR and consult the report saved into it. Figure 1 shows a diagram with the steps necessary to include the data calculated with the frailty application into the EHR.

are defined in what are called integrated cancer pathways¹ (or "kræftpakker" in Danish). Such standardization does not always apply to older patients such as those suffering from multiple myeloma. Older patients are less likely to receive all types of standard cancer therapies compared to younger individuals. Each therapy requires an adaption to reduce the risk of toxicities, especially when a sequential combination of therapies is chosen, for each of them add cumulative toxicities. Several non-cancer related factors influence the process of decision making. While chronological age per se is not sufficient to determine tolerance to cancer treatment, elderly patients usually suffer from multiple co-morbidities, have disabilities, cognitive impairments, depression, mobility impairment, malnutrition, polypharmacy, and/or live in a difficult psychosocial context. Thus, beside usual cancer-related factors such as tumor histology, site, extension, etc. the treatment decision for these patients, needs to be made in collaboration with the patient's values, preferences and based on his/her functional status. Comorbidity and the aging process can limit the capability of a patient to tolerate a certain therapy [3, 7].

In order to find the right balance between positive effects and malignant side effects on the patient's health status, we base the assessment of multiple myeloma cancer patients on a set of frailty markers. Frailty represents a state of reduced resistance to stress that can ultimately lead to increased vulnerability and risk of adverse outcomes such as death. The manifestations of frailty include weight loss, exhaustion, weakness, decrease in physical activity,

and so on, and represent anything that can interfere with the functional status of a patient [1].

A few studies show that older cancer patients have a high prevalence of frailty markers and some of them are predictive to cancer treatment toxicities [6, 10]. Therefore, in older cancer patients, the concept of frailty may be a useful approach to detect vulnerability and then base the treatment decisions on that. A frailty score can help modulate the proposed therapy while at the same time to minimize or to prevent complications. Our application categorizes patients as frail, unfit, or fit based on a numeric score calculated after collecting patient's information from a conglomerate of published and validated methods.

The Frailty Application

The creation of our application was influenced by the web-based application for desktop computers proposed in [8, 9]. In that system, the patients only go through the scoring once throughout the entire treatment process, notably at the time of diagnosis. We make it possible to have repeated assessments for the same patient at different times throughout the treatment process. This makes it possible to adjust the measures that were initially set during the treatment process and accordingly use the new assessment to optimize the rehabilitative and palliative measures. Our application allows for several scoring at different times during the patient's journey at the hospital. The first frailty scoring is carried out at the time of diagnosis, the second after three months and the final, third one, when the first line of treatment is completed or at the latest, after one

¹ <https://sundhedsstyrelsen.dk/en/disease-and-treatment/cancer/cancer-pathways>.

year of treatment. We also expanded the frailty scoring system in order to accommodate the registration of parameters that are particularly relevant for palliation and rehabilitation. Moreover, our application can be integrated with the electronic health record (Figure 1), it is web-based i.e. it runs smoothly on any operating systems and it is responsive meaning that it runs on any device, from desktop computers to smartphones (Figure 2).

Figure 1: Diagram of the overall system architecture and the process to include the frailty score into the EHR.

Nurses and doctors input a set of parameters for each patient, notably, the values of two standard assessments of quality of life EORTC QLQ-C15 [11] and EORTC QLQ-C30 [12], the questionnaires on activities of daily living (ADL) [4], the instrumental activities of daily living assessment (IADL) [5], and the Charlston's comorbidity index (CCI) [2]. By a weighted combination of these values, the application calculates the patient's frailty score and helps doctors identifying the most vulnerable patients and subsequently to target

individual interventions and therapy. Since many factors can interfere with the results of the assessment, each patient is evaluated at different times. In this way, the doctor has a better overview of the impact of the cancer on the patient's health at the time of each assessment. For instance in case of an aggressive or advanced cancer, a patient may be erroneously classified as frail but should not be refused an aggressive treatment on the basis of it. In fact, the erroneous frailty assessment can change with optimal cancer therapy.

We conducted a preliminary test with two patients, one nurse and one medical doctor. When asked about the project, the patients stated that *"..it makes perfect sense.."* and could be useful for their treatment. This initial test phase showed also that the patients do not have yet an attitude towards it. They preferred the nurse to collect the data, ask questions and enter the answers in the system instead of doing so themselves. The nurse and the doctor are instead very motivated and keen in using the application. According to the nurse, the application *".. can help nurses prepare and make every consultation more individual and useful since it will help us see the patients development.."*

Conclusions

The optimal management of elderly multiple myeloma patients is challenging. A correct estimation of the patient's vulnerability can guide the decision making process regarding the appropriate antineoplastic treatment. We developed a web application that performs all the functions that the hospital is doing physically, as well as new features that give also the patients the opportunity to fill out a part of their own frailty assessment. The application combines several

Figure 2: The user interface of the application as it looks like on a mobile phone (above) and on a desktop computer (below), respectively.

technical improvements over similar applications, especially an individual parametrization for each patient and a responsive interface, i.e. the support of various screen sizes and haptic input. It performs all functions in an elegant and functional way that is user-friendly, safe, secure and easy to further develop. From preliminary testing carried out on a daily basis in a highly sensitive environment like a hospital, the

application turned out to be robust and reliable. More testing is however necessary to help us further developing the application so that it can be tailored to older cancer patients.

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