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# New Perspective in the Follow-up of Chemotherapy-Induced Neutropenia: An all-out Role for Telemedicine 2.0!

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## Editorial

The prevention and treatment of chemotherapy-induced neutropenia (neutrophil count <0.5 × 109/L) remain a challenge for the clinician, especially in fragile patients receiving myelosuppressive drugs [1]. In fact, more than 20% to 30% of these patients exhibited complications, with potential life-threatening infections, requiring in-hospital management [1,2]. Moreover, an overall in-hospital mortality of about 10% is reported in this setting [1]. In this context, the mortality reported appears impacted by the prognosis of the underlying cancer or hematological malignancy. In this setting, the "health" status of the patient may also be a major prognostic factor. This later had been incorporated in prognosis through performance status index (e.g: OMS status, ECOG Performance Status) [3]. These include the age of the patient but also his comorbidities (e.g. chronic renal failure, chronic heart failure). In elderly patients, these factors (old age, comorbidities and performance status) help define patient categories at risk of complications: "frailty", "too sick" and "too good health" [4]. This is approach by the Charlson index. In terms of risk for FN, the therapeutic regimens have been classified as: "high-risk", "intermediate-risk" and "low-risk", with FN in more than 20% of case, between 10% to 20% and under 10%, respectively [1,2]. In this setting, mortality was shown to vary according to the Multinational Association of Supportive Care in Cancer (MASCC) prognostic index [2]. For example, this later is lower than 5% if the MASCC score is ≥ 21 or more than 40% if the MASCC score was <15 [2].

Chemotherapy-induced FN classically requires emergency hospital admission, especially for infection management (e.g. for parenteral antibiotherapy), until neutropenia resolves [2]. Several studies have explored risk stratification, along with the safety of managing "low-risk" patients as outpatients [5]. In this context, several studies have documented the utility of granulocyte colony-stimulating factor (G-CSF) and its pegylated forms for prophylaxis. G-CSFs have been indicated in myelosuppressive chemotherapy or for patients with a first episode of FN. In oncology setting, all patients classified as "high-risk" by MASCC (MASCC <15) or meeting clinical severity criteria should initially be admitted to the hospital for empirical antibiotic therapy [2]. In recent studies, carefully selected "low-risk" patients (MASCC score ≥ 21) may be candidates for antibiotherapy on an outpatient basis [6]. Concerning home management, only few retrospective and poorly-designed reports have been published in the scientific literature [1]. Thus, no structured management had been currently proposed for the management of chemotherapy-induced neutropenia. Moreover, these aforementioned reports mainly include only patients in "to good health", with no comorbidity and/or living in the city.

In this situation, telemedicine may have a potential role in the follow-up of chemotherapy induced neutropenia! This may be particularly the case for elderly patients; patient with several comorbidities, e.g. chronic heart failure or diabetes mellitus; or "frailty" or "too sick" patient. Indeed, these patients are particularly at risk of decompensation of their chronic pathologies by FN. Thus, these patients usually present for emergency hospitalization and re-hospitalization, which impairs the prognosis and the quality of their life. The rising prevalence of chronic diseases combined with population aging now represents a very real problem for Oncologist and Hematologist [7]. What's more, the management of these patients is a challenge for any healthcare professionals. Their needs eat up large amounts of medical resources, just as a shortage in the time careers can provide is beginning to be felt, with medical deserts and a lack of access to healthcare professionals, among

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other problems. Thus, our societies must “reinvent the medicine of today and also of tomorrow”. Telemedicine may be of aid in this setting, follow-up the FN and may optimize the management of chronic diseases, particularly by preventing emergency and repeat hospitalizations [8]. It may also make it possible to structure integrated care pathways. Telemedicine is also capable of providing a means for the various healthcare professionals to exchange with each other; and of facilitating access to medical resources.

Since the beginning of the 2000’s, numerous telemedicine projects have been conceived and developed in the area chronic disorders, especially in chronic heart failure [8]. Practically all of them have investigated “telemonitoring” or “tele management”, as it is also known. It is worth bearing in mind that those projects, particularly the earlier ones, more closely resembled telephone follow-up with care providers (such as a nurse) traveling to the patient's home, rather than telemedicine as we think of it nowadays with nonintrusive, automated, smart telemonitoring using remote sensors *via* modern communication technology or even artificial intelligence [8,9]. Hence in our opinion those studies represent the first generation of telemedicine projects: “telemedicine 1.0” [8]. Over the last 4 to 5 years, a second generation of projects has emerged in the heart failure area, particularly in developed countries [9]. These projects are known as "telemedicine 2.0", because they utilize the new Information and Communication Technology (ICT) and the web. Most of these projects rely on the usual connected tools for monitoring chronic disease, such as blood pressure meters, weighing scales, pulse oximeters, glucometers and thermometers, which relay the information collected *via* bluetooth, 3G or 4G and incorporate tools for interaction between the patient and healthcare professionals like telephone support centres, tablets and websites [8,9].

Recently, a telemedicine platform 2.0 has been successfully deployed by the Strasbourg University Hospitals. During February 2014 and April 2015, 175 patients were given the chance to use this platform [10]. The E-care platform was used on a daily basis by patients and healthcare professionals according to a defined protocol of use specific to each patient. The mean age of these patients was 72 years and the ratio of men to women was 0.7. The patients suffered from multiple concomitant diseases and had a mean Charlson index of 4.1. The five main diseases were heart failure in more than 60% of the subjects, anemia in more than 40%, atrial fibrillation in 30%, type II diabetes in 30%, and chronic obstructive pulmonary disease in 30%. During the study, 1,500 measurements were taken in these 175 patients, which resulted in the E-care system generating 700 alerts in 68 patients [11]. Some 107 subjects (61.1%) had no alerts during follow-up. Analysis of the follow-up of these 107 patients revealed that they had no clinically significant events that might eventually have led to hospitalization. Analysis of the warning alerts showed that the E-care platform automatically and non-intrusively detected any worsening of the patient's health. In fact, the E-care platform showed its ability to detect deterioration in health status *via* the multiple diseases of the patients studied, with sensitivity, specificity, and positive and negative predictive values of, respectively 100%, 30%, 89% and 100%. This platform could help track patients with predictable neutropenia after chemotherapy. In this setting, an experiment is quickly envisaged. As discussed above, this experiment will target elderly patients, especially elderly patient with several comorbidities, e.g. chronic heart failure or diabetes mellitus; and “frailty”.

To our opinion, such telemedicine tools may be particularly adapted to a better follow-up of chemotherapy-induced neutropenia.

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