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Short Communication

Health Remote Monitoring (He.Re.Mo.): Project Pilot Study on Lifestyle Changes in Cancer Patients Using Information and Communication Technologies (ICT)

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Abstract

Background: Chronic diseases such as cardiovascular disease, cancer and diabetes remain the leading causes of death and are often associated with poor diet and physical inactivity. Literature suggests that lifestyle changes can significantly influence cancer prognosis and treatment efficacy. This pilot study aims to improve the lifestyle of cancer patients using information and communication technologies (ICT) as part of the Health Remote Monitoring project. **Materials:** Participants who were not receiving chemotherapy at enrolment and had been diagnosed with cancer for more than five years used an app that allowed them to record their daily fruit, vegetable intake and steps; they received real-time feedback from the multidisciplinary team monitoring them. User satisfaction was assessed using the System Usability Scale. **Results:** A total of 19 subjects were effectively enrolled in the study. Significant improvements in fruit and vegetable consumption and physical activity (average daily steps of about 7,500) were observed, with variations due to weather and health problems. Satisfaction was rated as high (mean score: 78.6). **Discussion:** The study suggests the feasibility of using ICT to promote healthy lifestyles among cancer survivors. Participants increased their fruit and vegetable intake, improved self-efficacy, and satisfaction with the app was high. Personalized coaching and monitoring via ICT were effective in maintaining motivation and achieving goals. **Conclusion**: The success of this pilot suggests potential for broader application in monitoring various health parameters, providing a low-cost and accessible method for health promotion. Future research should explore the extension of these methods to other health parameters for comprehensive remote health monitoring.

Keywords: Remote patient monitoring system; ICT in healthcare; Cancer prevention; Fruit and vegetable intake; Physical activity monitoring

Introduction

Improvements in prevention, diagnosis and treatment have led to a steady decline in premature mortality from noncommunicable diseases. In 2000, a person aged 30 had a 22.7% chance of dying before the age of 70 from one of the four major global diseases (cardiovascular disease, cancer, chronic respiratory disease and diabetes). By 2019, before the COVID pandemic, this risk had fallen to 18.2%, with an estimated reduction of 20% [1,2].

With regard to cancer, the International Agency for Research on Cancer [3] reports that the five most common cancers in both sexes worldwide are lung (12.4%), breast (11.5%), colorectal (9.6%), prostate (7.3%) and stomach (4.8%), demonstrating that the burden of this pathology continues to affect entire communities, placing enormous emotional and financial pressure on populations and health systems.

Experts at the World Cancer Research Fund International have published recommendations for cancer prevention, including limiting fast food consumption, eating a healthy diet, taking regular physical activity and maintaining a healthy body weight [4]. The Center for Disease Control and Prevention [5] states that 50% of an individual's health is influenced by behavioral and lifestyle choices. Fortunately, the survival rate of cancer patients in Europe has increased over the years [6], although some health systems are not yet prepared to cope with this burden and many cancer patients do not have access to timely and high-quality diagnosis and treatment. Adequate fruit and vegetable (FV) intake effectively protects against cancer development and appears to counteract recurrence, as indicated in the "EBP-EBM Summary of the Scientific Rationale on the Importance of Fruit and Vegetable Consumption", prepared by the "Technical Table on Nutritional Safety (TaSiN)" established at the Italian Ministry of Health [7]. The European Code Against Cancer [8] also recommends an adequate intake of FV for both primary prevention and prevention of recurrence.

The Health Remote Monitoring (He.Re.Mo.) project is a large-scale system designed to collect physiological data from patients via biomedical sensors and assess their well-being outside the hospital [9]. The aim is to help patients with pre-existing pathologies to prevent complications and to make citizens aware that they can reduce the risk of developing chronic diseases and/or co-morbidities by knowing their risk factors. In line with these objectives, subjects are provided with a smartphone app that allows them to receive motivational messages and collect data on various factors simultaneously. A specially trained multidisciplinary team provides a web portal that allows them to visualize this data and provide each patient with personalized coaching aimed at improving lifestyle and habits [10].

This study addresses one of the objectives of the He.Re.Mo project, which is to improve lifestyle and nutrition. Our sample is represented by individuals diagnosed with cancer more than 5 years ago (i.e. long-term survivors) who are not receiving traditional chemotherapy at the time of enrolment. The aim of the study is: i) to assess the feasibility of recruiting these subjects for an innovative approach compared to traditional medical practice; ii) to evaluate procedures using information and communication technologies (ICT); iii) to verify whether self-monitoring combined with remote monitoring using ICT is effective in improving lifestyle and promoting adherence to adequate FV intake and physical activity.

Materials and Methods

An observational study was conducted for the first 30 days of December 2022 by the Food Hygiene and Nutrition Service of the Local Health Authority of Foggia (Apulia, Italy).

To carry out the study, digital devices were used within the information system. They included:

- A smartphone app reserved for each patient to monitor their parameters and receive motivational messages aimed at complying with the doctor's instructions.
- A web app reserved for the care manager to configure each patient's goals and the app, exchange messages, and view the information collected.

The system was able to provide coaching activities with information and feedback on lifestyle based on the goals assigned at enrolment (daily consumption of FV and physical activity), without interfering with any existing therapies. It allowed the collection of vital parameters, physical activity and diet both manually and automatically (when it was possible to wear enabled devices). Data were stored on the mobile device and shared with healthcare professionals, in accordance with the General Data Protection Regulation [11]. At the end of the experiment, patients were clinically reassessed using the same tools and asked to complete a satisfaction questionnaire (System Usability Scale, SUS), which measures user satisfaction on a scale of 1 to 5. The average SUS score was 68, with higher scores indicating greater satisfaction [12].

Recruitment was carried out in the city of Foggia (approx. 150,000 inhabitants, located in the north of Puglia, southern Italy) and was preceded by a public information meeting on the objectives, methods and procedures of the project. Participation was voluntary. After enrolment, each participant underwent the following steps:

- Clinical-psychological evaluation to assess the absence of major depression according to the criteria of Beck et al. [13].
- Detailed explanation of the aims of the study (methods, duration, expected effects).
- Assessment of inclusion criteria (cancer diagnosis for at least 5 years).
- Obtain informed consent.
- Installation of the He.Re.Mo. portal (available on PlayStore) on the patient's smartphone and creation of a patient profile.
- First access to the application and explanation of how it works.
- Delivery of the user manual (digital format available through the application).

Initially, 24 subjects were enrolled (19 women and 6 men), but after the start of the study, five participants withdrew due to objective difficulties in connecting to the information system. Therefore, 19 subjects really participated in the study, including 18 women with breast cancer and 1 man with prostate cancer. They all participated in the Med-Food Anticancer Program, a public health program designed by the team of the Food Hygiene and Nutrition Service of the Health Authority of Foggia [14,15], which promotes diet and daily physical activity to prevent the development of cancer, according to the recommendations of the World Cancer Research Fund [4] and the European Code against Cancer [8].

To calculate the sample size for the null hypothesis (Ho) of no difference in the achievement of the FV standard and steps at the end of the intervention, assessed using the independent t-test, the following parameters were considered:

Alpha error = 0.5

Power = 0.80

Expected difference between before and after = 4.0

Standard deviation = ± 3

Results

All 19 patients had comorbidities, alone or in combination, including hypertension (11%), hypercholesterolemia (6%), osteoporosis (5%), hyperthyroidism (3%), and other (8%) (Tab.1).

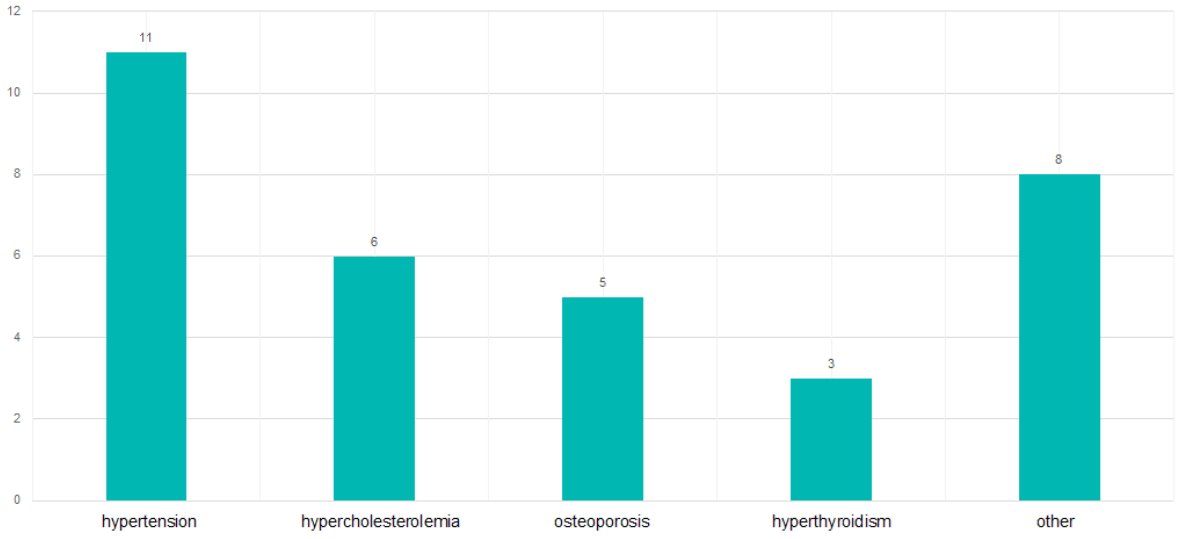

Table 1: Most frequent comorbidities (%) detected in the 19 enrolled patients.

Psychological tests [13] did not reveal any major depression in the participants either at the beginning or at the end of the study. Their ages ranged from 42 to 72 years, with a mean of 60 years and 6 months. Their weight ranged from 53 to 75 kg, with a mean of 67.60 kg, classified as 42% normal weight, 37% overweight, and 21% obese class I. Height ranged from 1.49 to 1.72 m, with a mean of 1.61 m. Body mass index ranged from 19.61 to 34.93, with a mean of 25.98.

The average number of steps taken by the 19 subjects during the 30-day experiment was approximately 7,500, with a maximum of 8,400 steps and a minimum of 5,800 steps. The lowest values were recorded during a week of bad weather (which effectively prevented walking outdoors) and during the first wave of influenza, which affected many subjects (Table 2).

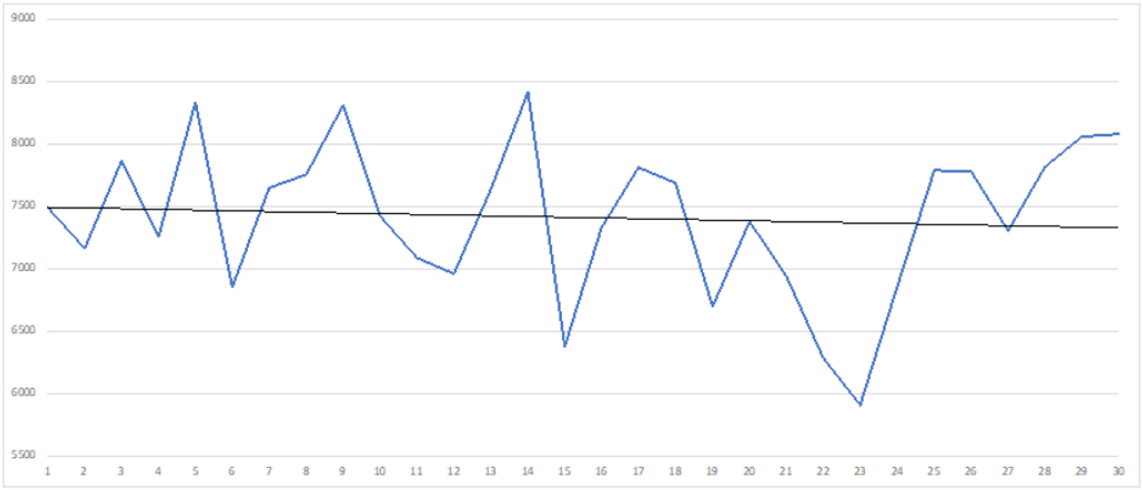

Table 2: Average steps taken by the 19 participants in the 30 days of the study.

The difference in FV consumption before and after the experiment was statistically significant ($p < 0.05$) for the patients who participated in the Med-Food Anticancer Program. They increased their daily steps from an average of 3.76 to 4.68. Patients who did not take part in the Med-Food Anticancer Program showed a non-statistically significant difference (from 4.33 to 4.66 steps). Self-regulation of eating habits, measured by the perceived self-efficacy questionnaire [16] improved significantly for all participants, from a minimum of 3 points (T1) to a maximum of 26.3 points (T2). Finally, using the System Usability Scale [12], volunteers rated their experience as "good" (mean score 78.6).

Discussion

When this pilot study was designed in 2021, there were not many studies on the topic [17]. The COVID-19 pandemic has stimulated research in this field [18], so much so that today several platforms for remote monitoring of cancer patients have been launched [19,20].

To our knowledge, this is one of the first studies in Italy. In our country, the Mediterranean diet (MD), recognized as a cultural heritage by UNESCO, is a widespread dietary model that is strongly based on the consumption of fruit and vegetables combined with physical activity [21]. The benefits of eating fruit and vegetables are well known and have been shown to improve the survival of cancer patients [7,8,22,23].

In the He.Re.Mo. project, we wanted to investigate the possibility of using simple but effective devices to improve the lifestyle of people with cancer. These people, even if they have not had a relapse for at least 5 years, continue to live in fear of a relapse and do not like the idea of having to go to the doctor or hospital for routine check-ups. They often fall into depression, preferring to avoid thinking and neglecting themselves, becoming seemingly lazy. This psychological state, combined with distrust of little-known technologies, made it difficult to recruit a sufficient number of patients in a short period of time. Unexpectedly, the participation of the 19 patients demonstrated the full feasibility of ICT methods in promoting adherence to correct lifestyles and new healthy habits. Our participants were fully satisfied with the results, as this type of monitoring made them responsible and motivated to achieve their goals, and aware of the importance of self-control. They added fruit and vegetables to their diet and continued to use the pedometer bracelet after the 30-day trial. As a result of this experience, they understood that ICT methods are important both for personal monitoring and for monitoring other functions (e.g. heart rate, sleep). In one case, heart rate monitoring detected a heart abnormality that saved the subject's life.

Our participants asked to be included in other ICT prevention programs because of the health benefits and ease of use. They also felt reassured by the fact that they could contact health professionals remotely to understand and resolve problems and

clarify doubts, without necessarily having to go to the doctor or hospital, which are not always immediately available.

Conclusion

Our study has shown that ICT methods can be an excellent tool to facilitate daily monitoring of critically ill patients. Despite the small sample size tested, we believe that the reliability and validity of the study were not compromised. These methods can also be used to routinely monitor other health parameters (e.g. heart rate, blood pressure, weight) without having to rely on regular visits to specialized facilities that are not always easy to reach. Their ease of use and low cost make them accessible to everyone in a world where globalization should include easy alternatives to conventional medicine.

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Ethical Guidelines: This study was approved by the Interprovincial Ethics Committee Area 1 (A.O.U. of Foggia, ASL FG, ASL BAT) with Opinion no. 86, EC, 2022 and authorized by the Local Health Authority of Foggia (Resolution no. 538 of 7 October 2022).

Conflict of interest declaration: All authors have no conflicts of interest.

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