

ROUTINE USE OF TELEMEDICINE IN CLINICAL PRACTICE

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Abstract

Even these days, the Czech Republic is lacking experience with the use of telemedicine applications directly in clinical practice, and especially in internal medicine where the sickness rate of the Czech population ranks the among the highest in European statistics. This hold true even though the European Commission has been largely promoting telemedicine activities as one of the possible solutions to the ever-growing prevalence of chronic diseases all over Europe. This article describes our results and one of the first experiences with the use of telemedicine applications in everyday clinical practice obtained from a pilot patient population at Olomouc University Hospital. The main purpose of our pilot studies was to objectively assess the effectiveness of telemedicine applications, their actual and organisation benefits and cost efficiency, and to compare them to standard health care. Based on the results of the pilot studies, our objective was to identify clinical areas with the highest potential for the further development and use of telemedicine in routine clinical practice on a larger scale and for teaching students at the Faculty of Medicine of Palacký University in Olomouc.

Keywords

telemedicine, remote monitoring, chronic diseases, eHealth

Introduction

The increase in the prevalence of chronic diseases (especially cardiovascular) and the management of long-term, high-quality and safe care for chronic patients is becoming a problem throughout the European Union, including the Czech Republic. Positions and statements made by the European Commission [1] reveal that the Commission is aware of this pressing demographic situation and that it supports the application of telemedicine and its implementation into routine clinical practice as one possible solution to this situation [2]. In its proclamations, the European Commission has been emphasizing a trend towards independent, healthy living and chronic disease management that will increase the patients' quality of life and safety of care, while slowing the growth rate of healthcare costs.

University Hospital in Olomouc has quite a lot of experience with various telemedicine applications that have been in use since 2005; at first, it was predominantly remote monitoring through implantable cardioverter defibrillators (namely *Home monitoring*®, *Biotronic CardioMessenger II/II-S* used by hundreds of patients). Since 2012, telemedicine has involved different activities that are unified in the Czech National eHealth Center, the Faculty of Medicine at Palacký University in Olomouc and University Hospital in Olomouc. The eHealth Centre, which is

part of the 1st Department of Internal Medicine – Cardiology, University Hospital in Olomouc, has gradually started to implement and use other telemedicine applications in clinical practice. These mainly include remote monitoring of arrhythmias and ECG, hypertension, chronic heart failure, diabetes mellitus and anticoagulation therapy in pilot patient populations. The main goal of these pilot studies was to objectively evaluate the effectiveness of telemedicine applications, analyse their real and organisation costs and benefits and compare them to standard care. In addition to cost efficiency, the studies also identified the reasons for the acceptance or rejection of telemedicine methods by patients. Based on the results obtained from the pilot projects, the objective was to identify clinical areas with the largest potential for further development and application in routine clinical practice on a large scale and also for teaching future doctors at the Faculty of Medicine, Palacký University in Olomouc.

In this context, we should also mention that only pilot patient populations could be included in the pilot studies because in the Czech Republic, unlike other EU countries [3], telemedicine is not covered by health insurance. In addition to lacking a system of reimbursement from public health insurance, all the required legal regulations have not yet been adopted and the issue of personal data protection has not yet been addressed within the eHealth concept in the Czech Republic. The first two remote ICD monitoring

procedures that have been included in the diagnosis code list of the General Health Care Insurance Company [4] are important first steps. The pilot trial at University Hospital in Olomouc and the Faculty of Medicine at Palacký University was possible thanks to project funds.

Methods

First, several clinical branches with the highest potential for clinical benefits were selected for the pilot study: the remote monitoring of ECG (ECG, N=20, Age 52.3); hypertension (HT, N=27, Age 62.9); chronic heart failure (CHF, N=22, Age 67.5); diabetes mellitus (DM, N=20, Age 63.2); and anticoagulation therapy (AKG, N=30, Age 65). A non-randomised prospective observational study was selected. The control group was a reference patient population provided with standard care at University Hospital in Olomouc. Patients were monitored from the beginning of 2013 until the middle of 2014 and always for a minimum period of 9 months.

Pilot studies in different clinical branches included patients over 18 with paroxysmal ventricular tachycardia and left ventricular ejection fraction (LVEF) > 50% (ECG); patients with resistant hypertension and systolic pressure measured repeatedly in the doctor's office > 160 mmHg (HT); patients with type 2 diabetes mellitus using intensified insulin therapy – insulin is administered at least three times a day and DM compensation is not satisfactory (the value of glycated haemoglobin HbA1C reported using the IFCC method over 6%, i.e. 60 mmol/mol); patients with paroxysmal ventricular tachycardia who had been using warfarin for at least 6 months; and finally, patients hospitalised for decompensated CHF (with a need for and administration of diuretics) over the previous six months.

The intervention group received sets that allowed them to telemonitor their diagnosis; these sets always included mobile gates (a telephone or a tablet) and the medical devices wirelessly transferred their measured data into a database. Together with a physician, individual patient care plans were designed and physicians were provided with access to the patient's daily health records. If necessary, patients were contacted and treatment plans were changed or adjusted. When placed into the register, all patients were properly instructed about how to use the telemonitoring device.

In addition to the clinical data in the database that were subsequently processed and evaluated by the Institute of Biostatistics and Analyses of Masaryk University, other analyses and questionnaires were used. They were assessed with respect to the principles and instruments of the Model for Assessment of Telemedicine MAST [5]. The evaluation of the organisation benefits was performed via standardized group interviews with health professionals and

members of the clinical and technical staff. In addition, a standardised questionnaire to assess the use of telemedicine technologies from the patient's perspective was used. At the same, by using the form for standardised interviews, patients were asked about their reasons for refusing participation in the pilot studies. The patients' quality of life was evaluated via the standardized Short Form 36 (SF-36) questionnaire. At the end of the study, a cost-benefit analysis was carried out to compare the cost of telemedicine and standard healthcare from the healthcare provider's perspective.

Results

During the study, several sets of data were collected and evaluated: clinical data, data about patient compliance, the number of hospitalizations required because of the primary diagnosis, quality of life assessment, reasons for non-participation, etc.

Clinical outputs of the pilot study

The most interesting results of the pilot studies in individual patient registers were as follows. The greatest clinical benefit was identified in patients with chronic heart failure (CHF), where a 40% decline of hospitalisations was registered in this pilot patient population compared to patients receiving standard treatment. Another major clinical achievement was reported in the telemonitoring of anticoagulation therapy. In this patient population, this method proved to be very exact compared to standard laboratory results; values were measured 52 times in 22 patients on the same day, both in a laboratory and with the CoaguChek telemedicine device. The correlation coefficient of values was 0.9216 and the average deviation was 0.2625 (0.05), as indicated in Figure 1. This intensive telemonitoring of warfarin therapy also proved to be safe – throughout the monitoring period (12 months), a dangerous range of the INR value was reported in only one patient (INR <1.5, >5; 0.08 %) and no embolism or bleeding was reported throughout the entire monitoring period.

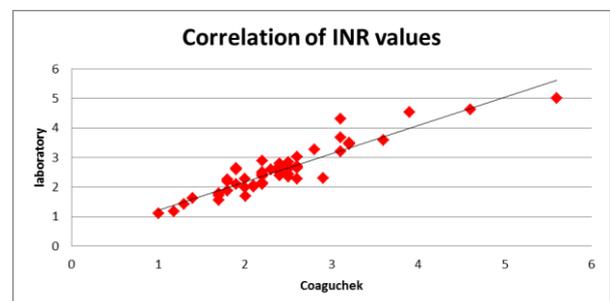


Fig. 1 shows the correlation of values (N = 52) measured in a laboratory and with the CoaguChek device.

As far as diabetes mellitus is concerned, the main clinical result was a 30% growth in the success rate in patients who, with the help of telemonitoring, managed to compensate glycated haemoglobin at a successful level < 53 mmol/mol compared to standard healthcare. On the other hand, no significant differences were reported in patient parameters achieved through telemedicine between the ECG and HT groups and standard treatment, which, to a large extent, might have been affected by the number of monitored patients in these registers.

Economic and organisation effects

The cost benefit analysis of telemedicine, if compared to standard treatment, saw the most significant results in the CHF group in which the number of hospitalised patients decreased by 40%. This means that telemedicine technology, which costs approximately 1,080 € per year, saves 5,500 € per patient on average.

Another major cost savings was reported in patients within the AKG group where the main savings concerned indirect medical costs (the patient's lost profit, transportation expenses to have blood samples taken every two weeks, etc.). The direct costs incurred by those paying for healthcare were comparable with standard care and savings generated by telemedicine could only be seen after the second year (the price of the Coaguchek device is offset by the costs of laboratory tests only after 12 months of usage).

No major differences were reported in the DM, ECG or HT groups with respect to the cost of using telemedicine procedures vs. standard healthcare.

Standardised group interviews with health care professionals showed that the greatest amount of time savings and the level of satisfaction with using telemedicine in clinical practice was seen in the CHF, AKG, DM and ECG groups. In the HT group, the satisfaction level was the same as with standard treatment procedures. However, all registers reported a significant necessity to provide telephone support to patients by the e-Health Centre supervisors, which was related to remote data transfer and the use of common ICT technologies, such as the Samsung smartphone, by patients who were above average age.

The acceptability by patients and quality of life

At the end of the study, patients were asked to fill in questionnaires asking them about the acceptability of telemedicine or to answer a short questionnaire to identify the reasons for their not participating in the study; both before and after the study, the patients filled in SF-36 questionnaires about the quality of their lives.

The refusal rate of telemedicine technologies across all pilot studies was 20% of all patients and another 10% withdrew during the study. The largest number of refusals was registered in the DM pilot study, while the smallest was in the CHF group. One interpretation of

this conclusion could be that patients with diabetes are those most concerned that their physician would be able to see that they are not following their restrictive dietary regime. In addition, DM is not immediately life-threatening and is a slowly-advancing disease. On the other hand, patients with heart failure feel more pressure and realize the severity of their condition and therefore, their compliance and satisfaction with using remote monitoring technologies was the greatest. A significant increase in perceiving the quality of life according to the SF-36 questionnaire was reported in the HF and AKG groups using telemedicine devices. The quality of life did not change for the ECG, DM and HT groups in the pilot studies compared to the control group of patients who received standard care.

Next, patients in 5 cases agreed to participate in the study, but were not able to control the telemedicine device (due to weaker eyesight and a degraded sense of touch and cognitive functions caused by the progression of their primary disease).

Conclusion

Modern telemedicine devices have been tested for routine clinical practice under pilot studies over the past two years at University Hospital in Olomouc. New treatment procedures, organisation methods and communication interfaces were tried and the perspectives of patients, healthcare professionals and healthcare providers were explored. The telemedicine technologies were later assessed against standard healthcare in terms of their clinical effects, organisation benefits and cost savings.

The results of our pilot projects show that telemedicine resources can be effectively used even for older age groups in routine clinical practice and that they provide a number of benefits. Telemedicine devices proved to be the most beneficial to patients, healthcare professionals and healthcare providers in the case of chronic heart failure, anticoagulation therapy and diabetes mellitus. Based on these findings, modern treatment procedures were included into the syllabi at the Faculty of Medicine of Palacký University in Olomouc. Based on the results and reactions from patients and physicians, a new comprehensive programme to monitor heart failure, anticoagulation therapy and diabetes mellitus has been formed and is being further developed at University Hospital in Olomouc.

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