

# The effectiveness of using ECG teletransmission during emergency medical team interventions

Tomasz P Ilczak (✉ [tilczak@ath.bielsko.pl](mailto:tilczak@ath.bielsko.pl))

University of Bielsko-Biała <https://orcid.org/0000-0003-2478-9045>

Marek Stanisław Kawecki

University of Bielsko-Biała

Monika Mikulska

University of Bielsko-Biała

Rafał Bobiński

University of Bielsko-Biała

Michał Tomasz Ćwiertnia

University of Bielsko-Biała

Wioletta Waksmańska

University of Bielsko-Biała

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## Research article

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# Abstract

**Background** To determine the importance of ECG teletransmission on the time required for decisions on diagnosis and treatment and the transport of patients with myocardial infarction. **Methods** This study is retrospective in character and concerns the regional activities of the Bielsko Emergency Medical Services and the possibility of sending medical data electronically from a patient's location to the clinic of interventional cardiology (CIC). Group A (n=237) included patients in whom the Medical Response Team confirmed an ST-ACS and carried out an ECG with data teletransmission to the CIC. Group B (n=101) included patients in whom the Medical Response Team confirmed an ST-ACS and carried out an ECG without teletransmission. For both groups, the Medical Response Team recorded the time of arrival at the patient's location and the time when the patient was handed over to the CIC. **Results** A group of 638 patients were identified in whom the chest pain was of cardiac origin. Of these patients, 338 were identified as patients with diagnosed ST-ACS. A significant dependence was demonstrated of the time  $t$  [mins] of teletransmission ( $p=0.00308$ ). A significant dependence was demonstrated of the effect of distance  $s$  [kms] ( $p=0.00000$ ). A significant dependence was demonstrated of the time  $t$  from the place of residence, taking into account the distance  $s$  ( $p=0.00929$ ). **Conclusion** Using ECG teletransmission in pre-hospital procedures shortens the time for diagnosis and transport of patients with ST-ACS, and thus improves the results of treatment.

# Abstract

## Background:

To determine the importance of ECG teletransmission on the time required for decisions on diagnosis and treatment and the transport of patients with myocardial infarction.

## Methods:

This study is retrospective in character and concerns the regional activities of the Bielsko Emergency Medical Services and the possibility of sending medical data electronically from a patient's location to the clinic of interventional cardiology (CIC). Group A (n=237) included patients in whom the Medical Response Team confirmed an ST-ACS and carried out an ECG with data teletransmission to the CIC. Group B (n=101) included patients in whom the Medical Response Team confirmed an ST-ACS and carried out an ECG without teletransmission. For both groups, the Medical Response Team recorded the time of arrival at the patient's location and the time when the patient was handed over to the CIC.

## Results :

A group of 638 patients were identified in whom the chest pain was of cardiac origin. Of these patients, 338 were identified as patients with diagnosed ST-ACS. A significant dependence was demonstrated of the time  $t$  [mins] of teletransmission ( $p=0.00308$ ). A significant dependence was demonstrated of the

effect of distance  $s$  [kms] ( $p=0.00000$ ). A significant dependence was demonstrated of the time  $t$  from the place of residence, taking into account the distance  $s$  ( $p=0.00929$ ).

## **Conclusion :**

Using ECG teletransmission in pre-hospital procedures shortens the time for diagnosis and transport of patients with ST-ACS, and thus improves the results of treatment.

Keywords: emergency medicine, acute coronary syndrome, teletransmission,

## **Background**

Data transmission in the field of medicine is used widely for sending diagnostic data and conducting teleconsultations, as well as video analysis of a patient's condition. Teletransmission involves cooperation between a medical specialist and a person benefitting from the service – that is a patient – without the need for personal contact. In the Polish healthcare system, this type of teletransmission began at the beginning of the 21st century, and is currently a permanent feature of the diagnostic process for acute coronary syndrome (ACS). [1] Using this method, data is transmitted directly from a patient's location to a specialist clinic, where a printed or electronic ECG graph readout is analysed by a cardiologist. Thanks to teletransmission, ST-ACS can be diagnosed and pre-hospital treatment can be begun by the Medical Response Team (MRT) during transport of the patient to the cardiology surgery clinic in order to carry out percutaneous coronary intervention (PCI).

## **Methods**

This study is retrospective in character and concerns the regional activities of the Bielsko Emergency Medical Services and the possibility to send medical data electronically from a patient's location to the clinic of interventional cardiology (CIC) in Bielsko-Biała. The study was conducted based on an ECG teletransmission system. The information used is from Medical Response Team Intervention Report Cards completed by Medical Response Centre managers. The following criteria were applied to limit the number of patients participating in the study :

### **Study inclusion criteria:**

patients with diagnosed myocardial infarction ST-ACS,

residents of the Medical Response Centre administrative area,

patients aged 20 or above, irrespective of gender,

### **Study exclusion criteria:**

patients whose chest pain was of different origin than cardiac,

patients who were not diagnosed with ST-ACS,

patients who suffered sudden cardiac arrest during medical intervention,

patients transported to a different clinic of interventional cardiology not in Bielsko-Biała,

The patients in the study group were divided into two sub-groups. Group A (n=237) included patients in whom the Medical Response Team confirmed an ST-ACS and carried out an ECG with data teletransmission to the CIC. Group B (n=101) included patients in whom the Medical Response Team confirmed an ST-ACS and carried out an ECG without teletransmission. For both groups and for all patients, the Medical Response Team recorded the time of arrival at the patient's location and the time when the patient was handed over to the CIC. The next stage of the study recorded the time  $t$  [mins] required for decisions on diagnostics, treatment and transport of patients with myocardial infarction, and the time difference between the time of arrival of the MRT at the patient's location and the time the patient was handed over to the CIC. The distance  $s$  [kms] from the patient's place of residence to the CSC was calculated based on the geographical coordinates (GPS) of the two points.

**To prove the assumed research aim, statistical analysis of the data was conducted :**

to define the effectiveness of using teletransmission in relation to time  $t$  [mins],

to determine the influence of time  $t$  [mins] of the patient's place of residence within the Bielsko-Biała city boundaries or the Bielsko district, taking into account the distance  $s$  [kms].

**Research into the effect of the time of day or night on the time  $t$  [mins] did not demonstrate a statistically significant dependence.**

Statistical analysis of the data was conducted using the STATISTICA software package, licence no. JPZP602D415110AR-9. The selection of statistical analysis method was based on qualitative and quantitative variable types and on ordinal and interval scale types, as well as compatibility of distributions with normal distributions and skewness and kurtosis values. For the qualitative variables, that is place of residence, non-parametric tests were used. Their mutual dependencies were verified by chi-square independence tests. Verification of the dependencies of interval scale type variables, i.e. route and time taken, on category factors, i.e. location and time of day, were conducted using variance analysis wherever the assumptions required by this analysis were fulfilled. The required variance homogeneity was checked using the Levene test. The normality of distribution was verified using the Kolmogorow-Smirnow test. For significant principal effects and interactions, the Tukey HSD test was used for post hoc analysis. The effects of disturbing factors were verified using covariance analysis. If the required assumptions were not met, Kruskal-Wallis rank variance analysis was used. In all tests, the result was taken as significant for  $p < 0.05$ .

## Results

In the three-year study period, the number of responses to patients with chest pain totalled 1200. After applying inclusion and exclusion criteria, a group of 638 patients were identified in whom the chest pain was of cardiac origin. Of these patients, 338 were identified as patients with diagnosed ST-ACS.

## **The demographic data of the patients in the study group is presented in Table 1 (in the Supplementary Files).**

To achieve the study aims, results were selected that documented the effect of teletransmission on the time  $t$  for diagnostics and for transport of patients with myocardial infarction to the CIC. Evaluation was made of the dependency of time  $t$  as regards the use or non-use of teletransmission and the place of residence within the municipality or district.

Covariance analysis was used to take into account the distance  $s$  [kms] from the patient's location to the CIC or to a hospital with a cardiology ward, the use or non-use of teletransmission, and the place of residence within the municipality or district.

A significant dependency was demonstrated between  $t$  [mins] and teletransmission ( $p=0.00308$ ). A significant effect was demonstrated of distance  $s$  [kms] ( $p=0.00000$ ). A significant dependency was demonstrated between time  $t$  and place of residence, taking into account distance  $s$  ( $p=0.00929$ ).

## **Discussion**

According to many authors, teletransmission of ECG in cases of suspected ACS assists medical response teams in making the correct diagnosis, and speeds up the decision regarding the start of treatment [1-6]. Triverdi et al. [7], conducted a study in the USA into the emergency medical response system, in which teletransmission of ECG is not obligatory for patients with suspected acute myocardial infarction (AMI). The results obtained confirmed the high effectiveness in diagnosing ST-ACS by members of emergency medical response teams. Grieko et al. [8], in research on the emergency medical response system in Italy, demonstrated the influence of ECG teletransmission on shortening the time between the first chest pains and the start of treatment. Tekerlsen et al. [9], in their study on the Danish emergency medical system, where ambulance teams use ECG teletransmission, demonstrated a shortening of delays in the start of ST-ACS myocardial infarction treatment due to fast diagnosis and transport of patients directly to cardiology surgery wards. Dudek et al. [10], presented current standard procedures in Poland for cases of Acute Coronary Syndrome, which places particular emphasis on the model of the early intervention strategy based on a network of cardiology surgery clinics that maintain 24-hour hemodynamic shifts. Kleinrok et al. [11], demonstrated that teletransmission of ECG data and teleconsultations reduce system delays. ECG teletransmission is particularly useful in sparsely-populated rural areas with access to only one hospital in the region able to conduct primary percutaneous coronary intervention (PCI). Zimoch et al. [12], emphasised the influence of delays in diagnosis and treatment on rates of illness and morbidity among patients with ST-ACS. In cases where ECG data teletransmission was conducted, the time from the moment the MRT was called to the moment reperfusion therapy was started was significantly shorter, and the percentage of indirect transport to a hospital with PCI was lower. De Luca et al. [13], proved that

every 30 minutes of delay in starting reperfusion therapy is linked to an 8% rise in morbidity. Our research has shown that if teletransmission is used, the time  $t$  for diagnosis and transport of the patient to the CIC is significantly shorter than if teletransmission was not conducted. A significant dependency has also been shown between time  $t$  and a patient's place of residence in the Bielsko-Biała municipality or within the Emergency Medical Centre's administrative area. A significant effect has been shown of the distance  $s$  [kms] from the patient's location to the CIC. Research into the effect of the time of day or night on time  $t$  [mins] showed no statistically significant dependencies.

## Conclusions

To summarise, the research results presented above confirm that use of ECG teletransmission in pre-hospital procedures results in shortening the time for diagnosis and transport of patients with ST-ACS, and thus improves the results of treatment.

## List Of Abbreviations

Clinic of interventional cardiology - CIC

Electrocardiogram – ECG

ST elevation myocardial infarction - ST-ACS

Medical Response Team – MRT

Primary [percutaneous coronary intervention](#) – PCI

## Declarations

Ethics approval and consent to participate

Local ethics committee ruled that no formal ethics approval was required in this particular case.

Consent for publication

Not applicable.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

## Authors' contributions

All authors have read and approved the manuscript

TI, MK, MM, conceived the study, designed the trial, RB,MC,WW, supervised the data collection TI, MM, provided statistical advice on study design and analyzed the data, TI drafted the manuscript, and all authors contributed substantially to its revision

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## Tables

Due to technical limitations, tables 1 through 4 are only available as downloads in the supplemental files section.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1.jpg](#)
- [Table4.jpg](#)
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