Advanced Telemedicine Solutions for High-Quality Medical Assistance at Sea †

Francesco Amenta 1,2,3, *, Marzio Di Canio 1,2, Antonio Arcese 3, Francesco Bajani 3, Ciro Ruocco 1,3 and Fabio Sibilio 2

1 Telemedicine and Telepharmacy Center, School of Medicinal and Health Products Sciences, University of Camerino, 62032 Camerino, Italy
2 Research Department, International Radio Medical Center (C.I.R.M.), 00144 Rome, Italy
3 CIRM SERVIZI SRL, 00144 Rome, Italy
* Correspondence: francesco.amenta@unicam.it; Tel.: +39-338-7888549

Abstract: The medical assistance to seafarers was not always improved in parallel with advances in medicine and telecommunications. Today technology offers systems including digital devices helping in collecting symptoms to be referred correctly to remote physicians. CIRM SERVIZI, the spin-off of Centro Internazionale Radio Medico (C.I.R.M.), and the Italian TMAS center, have developed an advanced system called CIRM PREMIUM. This aimed at offering extensive telemedicine solutions for the treatment of illnesses or injuries on-board ships. The objective of this paper is to present the results of offered service with CIRM PREMIUM and the standard basic TMAS service given by C.I.R.M. to ships not equipped with advanced technologies. We have considered 400 seafarers assisted on-board ships from 1 January 2020 to 31 December 2021 including 200 on-board ships equipped with CIRM PREMIUM (Test Group, TG) and 200 were on-board ships requiring the C.I.R.M. standard free telemedical assistance (Control Group, CG). The five most frequent different disorders assisted by C.I.R.M in the given period were considered. Diseases of the circulatory and respiratory systems were also considered to be the most frequent cause of medical emergencies on board. Data were analyzed comparatively by analysis of variance (ANOVA) and by the Chi-squared test. The average time for a patient’s complete recovery was 115.1 ± 12.8 h (4 to 5 days) in the TG group and 132.8 ± 14.4 h (5 to 6 days) in the CG group. From a temporal point of view, PREMIUM patients showed an improvement in 12–24 h from the first request for medical advice, versus 36–48 h for those using the standard medical service. The patients who fully recovered on board were 48.8% for the TG group and 27.46% for the CG. Telemedical assistance resulted in avoiding diversions in 73.7% of cases in the PREMIUM service and in 43.7% in the standard service. The results of our analysis revealed that the CIRM PREMIUM services provide a better and quicker outcome for patient conditions and cause significantly less ship diversions for medical reasons. This indicates that technological progress can offer relevant advantages for treating diseases or accidents on-board ships. The presence of telemedical devices on board, their larger and constant use and a closer collaboration from the ship will offer seafarers adequate health protection and will reduce the present disadvantage of being ill while at sea.

Keywords: telemedicine; CIRM PREMIUM; seafarers health; onboard medical assistance

1. Motivation

CIRM PREMIUM consists of two components, a Tele Medicine Vessel Software (TMV) and a Tele Medicine Corner (TMC). Figure 1 presents TMC medical components. TMV is an automated medical request system guiding the ship’s medical officer to select the symptoms being reported and answer specific questions pertaining to those symptoms.
In case of injuries or illnesses at sea, a medical officer is in charge of the patient. On land, dedicated medical centers called Telemedical Maritime Assistance Services (TMAS) are available to give advice [1]. In this situation, the doctor has never seen the patient, and probably never will, will rarely talk with the patient and has no previous medical history of the person they are treating. In this particular scenario, the doctor will need the best possible information about the state of the patient, whereas the medical responsibility remains with the captain.

Unfortunately, medical assistance to seafarers was not always improved in parallel with advances in medicine and telecommunications. Requests for medical assistance from ships to a specialized ashore center, in general, continue to follow the same procedure used probably 100 years ago. Today technology offers systems using digital devices that help in collecting symptoms to be referred correctly to the remote physicians. Moreover, digital devices can capture and transmit biomedical vitals, monitor progress, capture images of anatomical parts of the body, etc.

CIRM SERVIZI, the spin-off of Centro Internazionale Radio Medico (International Radio Medical Center, C.I.R.M.), the Italian TMAS, has developed an advanced system for offering expansive telemedicine solutions for the treatment of illnesses or injuries on-board ships [2]. This advanced system named CIRM PREMIUM has been adopted by some leading international shipping companies, which are using it as a standard of medical assistance on-board their ships. This paper has compared the results of the CIRM PREMIUM service with the standard basic TMAS service given by C.I.R.M. to ships not equipped with the advanced technologies offered by CIRM PREMIUM.

2. Approach

The effectiveness of the CIRM PREMIUM service was analyzed comparatively versus the standard free medical service offered by C.I.R.M. For this analysis, we have considered 400 cases of patients assisted on-board ships from 1 January 2020 to 31 December 2021. Two hundred patients were on-board ships equipped with CIRM PREMIUM facilities (Test Group, TG) and 200 were on ships receiving the C.I.R.M. standard free telemedical assistance (Control Group, CG). Patients of the CG were randomly selected from the 15,178 patients assisted by C.I.R.M. during the above elapse of time among subjects with the same diagnosis and triage code at the admission of those undergoing Premium service. The results of the two different services were compared in terms of (a) Patient outcome; (b) Days of treatment; (c) Diversions avoided; (d) Data missing.

Disorders considered for this study included the five top pathologies assisted by C.I.R.M in the 2 years considered, namely in the order Diseases of the digestive system; Certain infectious and parasitic diseases; Diseases of the musculoskeletal system and connective tissue; Injury, poisoning, and certain other consequences of external causes; Diseases of the skin and subcutaneous tissue. Diseases of the circulatory and respiratory systems were also considered to be the most frequent cause of medical emergencies on board.

Patients of the CG were randomly selected from the 15,178 patients assisted by C.I.R.M. during the above elapse of time among subjects with the same diagnosis and triage code.
at the admission of those using the PREMIUM service. Parameters examined included (a) Patient outcome; (b) Days of treatment; (c) Diversions avoided; (d) Data missing. Data of days of treatment were analyzed comparatively by analysis of variance (ANOVA). The Chi-Squared test was used to determine the significance of differences in other parameters considered between TG and CG.

3. Testing Outcomes

Data of patient outcomes indicated in the TG group an improvement of 83% of cases, no changes of 16% of cases, and worsening of 1% of cases. In the CG, the improvement occurred in 49% of cases, the conditions of 41% of patients were unchanged, in 2% of cases patient’s conditions worsened, whereas for 7% of cases the ships did not maintain contact and therefore we do not know the outcome of the assistance. The average time for a patient’s complete recovery was 115.1 ± 12.8 h (4 to 5 days) in the TG group and 132.8 ± 14.4 h (5 to 6 days) in the CG. From a temporal point of view PREMIUM patients showed an improvement in 12–24 h from the first request for medical advice, versus 36–48 h for those using the standard medical service. Patients fully recovered on board were 48.8% for the TG group and the 27.46% for the CG group.

Based on the diagnosis, triage code and reported subjective symptomatology, the need of ship diversion for the patient’s prompt hospitalization occurred in the 10.86% of cases for the TG and in the 11.63% of cases for the CG. Medical interventions from ashore resulted in avoiding diversions in 73.7% of cases in the PREMIUM service and in 43.7% in the standard service.

Data missed that can be relevant for the provision of medical advice were significantly less in the TG which in general uses a data exchange platform with fields to be filled-in compulsorily compared with the CG. This platform is compliant with the General Data Protection Regulation (GDPR). The name and the nationality of the patients were missing, respectively, in 30.2% and in 25.6% of CG cases. Patient’s age was missed in 31% of cases, whereas the patient’s rank, the knowledge of which is important to identify possible occupational diseases, was not mentioned in the 36% of CG requests for medical advice. Ship’s position, port of departure, destination and nearest port which are information necessary for epidemiological reasons, in cases of emergencies such as a diversion required, a stop at a port, disembarkation, or hospitalization were not communicated in more than 40% of cases. The inventory of medicines available on board, based on which the TMAS doctor can give their prescriptions was missed in the 44.7% of cases.

4. Conclusions

The results of our analysis with a better outcome and a quicker improvement of the patient conditions as well as significantly fewer ship diversions for medical reasons indicate that technological progress can offer relevant advantages for treating diseases or accidents on board ships. Probably thanks to friendly technologies, the old consideration that because of the scarce possibilities of assistance, getting sick on board a ship at sea does not allow one to be properly cured must be debunked. The presence on board of telemedical devices, their larger and constant use, and a closer collaboration from the ship side will offer seafarers adequate health protection and will reduce the present disadvantage of being ill while at sea.

Author Contributions: Conceptualization, F.A. and M.D.C.; methodology, F.A., A.A., M.D.C., C.R., F.B. and F.S.; formal analysis, A.A., M.D.C., F.S.; investigation, C.R., F.B.; data curation, A.A., M.D.C., F.S.; writing—original draft preparation, A.A., M.D.C.; writing—review and editing, F.A., C.R., F.B.; supervision, F.A.; funding acquisition, F.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by a grant No. 1624 from the ITF Seafarer’s Trust.

Informed Consent Statement: Not applicable.
Data Availability Statement: The data presented in this study are available from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References