



Enfermedades Infecciosas y Microbiología Clínica

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Original article

Application of telemedicine in infectious diseases[☆]

Monfort-Vinuesa Carlos^{a,*}, Gil-López Pedro^b, Ramírez-Olivencia Germán^c, Chivato-Pérez Tomás^d, Coca-Benito David^e, Mata-Forte Tatiana^f

^a FEA Medicina Interna, Hospital La Fuenfría, SERMAS, Cercedilla, Madrid, Spain

^b Teniente Coronel Médico, Jefe Servicio de Telemedicina, Hospital Central de la Defensa Gómez Ulla, Madrid, Spain

^c FEA Medicina Interna, UAN, Sección de Infecciosas, Hospital Central de la Defensa Gómez Ulla, Madrid, Spain

^d Facultad de Medicina, Universidad San Pablo CEU, Madrid, Spain

^e Comandante Médico, Adjunto Servicio de Urgencias, Hospital Central de la Defensa Gómez Ulla, Madrid, Spain

^f Capitán Médico, Servicio de Medicina Interna, Hospital Central de la Defensa Gómez Ulla, Madrid, Spain



ARTICLE INFO

Article history:

Received 23 January 2021

Accepted 12 March 2021

Available online 7 July 2022

Keywords:

Telemedicine

Military

Infectious disease

ABSTRACT

Introduction: Infectious pathologies can benefit from the application of Telemedicine (TM). This study provides a description of the infectious pathology treated by the Telemedicine Service of the Hospital Central de la Defensa Gómez Ulla (STM-HCDGU).

Methods: Analysis of the e-consultations made by members of the Armed Forces (FA) of Spain displaced to the area of operations (ZO) in the period between 01/1/2015 and 31/12/2018 who developed infectious symptoms.

Results: 127 infectious diseases were diagnosed, the most frequent being those of respiratory etiology and later malaria. Geographically Africa and embarked contingents were the most significant. It was necessary to evacuate 18 patients to the HCDGU, being the diagnosis of malaria the most frequent reason for evacuation, cause of the only fatal case.

Conclusions: infectious diseases benefit from the application of TM, being an important tool for the diagnosis and treatment of these, constituting an opportunity to expand to other displaced or remote populations.

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Aplicación de la telemedicina en enfermedades infecciosas

RESUMEN

Introducción: Las patologías infecciosas pueden beneficiarse de la aplicación de la Telemedicina (TM). Este estudio realiza una descripción de la patología infecciosa atendida por el Servicio de Telemedicina del Hospital Central de la Defensa Gómez Ulla (STM-HCDGU).

Métodos: Análisis de las e-consultas realizadas por miembros de las Fuerzas Armadas (FA) de España desplazados a zona de operaciones (ZO) en el periodo comprendido entre 01/1/2015 y 31/12/2018 que desarrollaron sintomatología infecciosa.

Resultados: Se diagnosticaron 127 enfermedades infecciosas, siendo las más frecuentes las de etiología respiratoria y posteriormente la malaria. Geográficamente África y contingentes embarcados fueron los más significados. Fue necesario evacuar 18 pacientes al HCDGU siendo el diagnóstico de malaria el motivo de evacuación más frecuente, causa del único caso mortal.

Conclusiones: las enfermedades infecciosas se benefician de la aplicación de la TM, siendo una herramienta importante para el diagnóstico y tratamiento de estas, constituyendo una oportunidad para ampliar a otras poblaciones desplazadas o remotas.

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Palabras clave:

Telemedicina

Militar

Enfermedad infecciosa

DOI of original article: <https://doi.org/10.1016/j.eimc.2021.03.009>

* Corresponding author.

E-mail address: carlos.monfort@salud.madrid.org (C. Monfort-Vinuesa).

Introduction

Telemedicine (TM) is a term coined in the 1970s and whose literal meaning is healing at a distance.¹ The World Health Organization defines it as the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities.²

Infectious diseases can benefit from the application of TM.^{3,4} In two studies, Eron et al.⁵ and Assimacopoulos et al.⁶ obtained significant results that demonstrated how the application of TM facilitated satisfactory clinical results, faster recoveries, presenting a shorter duration of antibiotic therapy and hospitalisation, and reducing the number of transfers due to worsening than in comparable hospitalised patients.

In the military field, TM is a very useful tool. The US Army has documented that casualties due to infectious diseases have a specific weight among the reasons for casualties in the area of operations (AO).⁷

The Telemedicine Service of the Hospital Central de la Defensa Gómez Ulla [Gómez Ulla Central Military Hospital] (TMS-HCDGU) was the first in Spain and was inaugurated in 1996, with the name, Telemedicine Unit.⁸

The objective of this study is to describe and detail the aetiology of infectious diseases treated by the TMS-HCDGU.

Materials and methods

Target population

Members of the Spanish Armed Forces (AF) over 18 years of age relocated to the AO between 1 January 2015 and 31 December 2018.

Inclusion criteria

Members of the AF with infectious symptoms and who request e-consultation with the TMS-HCDGU.

Exclusion criteria

Reason for consultation whose final diagnosis is not of infectious aetiology.

Telemedicine service logistics

The HCDGU is the upper echelon of health support for military personnel, guaranteeing uninterrupted coverage throughout the year. The TMS is integrated within it, providing assistance and subsequent confirmation or modification of diagnoses and treatments of the diseases consulted for.

E-consultations are carried out by e-mail, video conferences/video calls via satellite. The TMS-HCDGU refers the consultation to the doctor whose specialisation is related to the suspected diagnosis. After evaluating the clinical history issued, the specialist can request more information or make a diagnosis, prescribe treatment, follow the patient's evolution and, where necessary, issue a recommendation for evacuation to national territory.

Variables collected

The variables collected included epidemiological (age, sex, date of e-consultation), geomilitary (type of base, land/naval location)

and medical data (history, diagnosis of the process, treatment, evacuation).

The data was analysed with the SPSS program (IBM Statistics V25.0), presenting the frequencies and percentages of the qualitative variables with their 95% confidence interval, and the means and confidence interval of the quantitative variables.

Permissions

The study was authorised by the Mando de Operaciones [Operations Command] of the Estado Mayor de la Defensa [Chiefs of Defence], Ministry of Defence Health Information System, as well as by the Teaching Commission and the Medicines Research Ethics Committee of the HCDGU.

Results

The sample consisted of 644 records, with a total of 127 e-consultations in relation to infectious disease after applying the exclusion criteria, 19.7% (95% CI, 16.7–23). The gender distribution was 120 men and 7 women, with a mean age (95% CI) of 33.31 years (31.6–35).

Based on the annual distribution of e-consultations, an increase in these was observed, with the maximum in 2017 being 52 (41%). The analysis shows a growing trend of e-consultations for infectious diseases (Fig. 1).

E-consultation requests to the TMS-HCDGU were most commonly from naval ships. Next were contingents based in Africa, with these two categories making up 85% of the total. There were no e-consultations from Latin America, since there is only one cooperation mission, and none of the diseases consulted were of infectious aetiology. As an in-demand specialisation Internal Medicine stands out primarily with 84 cases, 61% of the total.

Acute pharyngotonsillitis was the disease most frequently consulted for, followed by malaria. Combining upper and lower respiratory tract diseases, a total of 39 (30.7%) e-consultations were obtained (Table 1).

A total of 18 cases (14.27%) were evacuated to the HCDGU. 50% of malaria cases were evacuated, which is the most common infectious disease requiring evacuation. Viral infections were evacuated in a proportion of 33% (mononucleosis and dog-bite rabies). The cases evacuated belonging to the category of "other" were septic arthritis and meningitis.

The patient who died of malaria had a correct diagnosis, but the evolution was not satisfactory due to complications related to the disease itself.

Discussion

Our study confirms that infectious diseases are among the most common medical conditions experienced by the AFs while serving missions outside their home countries.⁹ The specific weight of casualties or unavailability to perform assigned tasks (estimated by consensus to be 3 days) due to disease of infectious aetiology is important.¹⁰ Diagnosing effectively allows to reduce casualties and carry out a preventive health policy for future contingents.

Lappan¹¹ classified the reasons for e-consultation from 2004 to the first quarter of 2018. Of 14,439 e-consultations, 1,060 were of infectious aetiology, which represents 7.3% in 13 years. The percentage difference between our data and that collected by Lappan can be explained by a different geographical distribution of the contingents between both studies. Despite the limitations of our study, with fewer e-consultations and a shorter study period, many infectious diseases were observed, constituting an advantage that enabled us to identify, classify and understand which entities

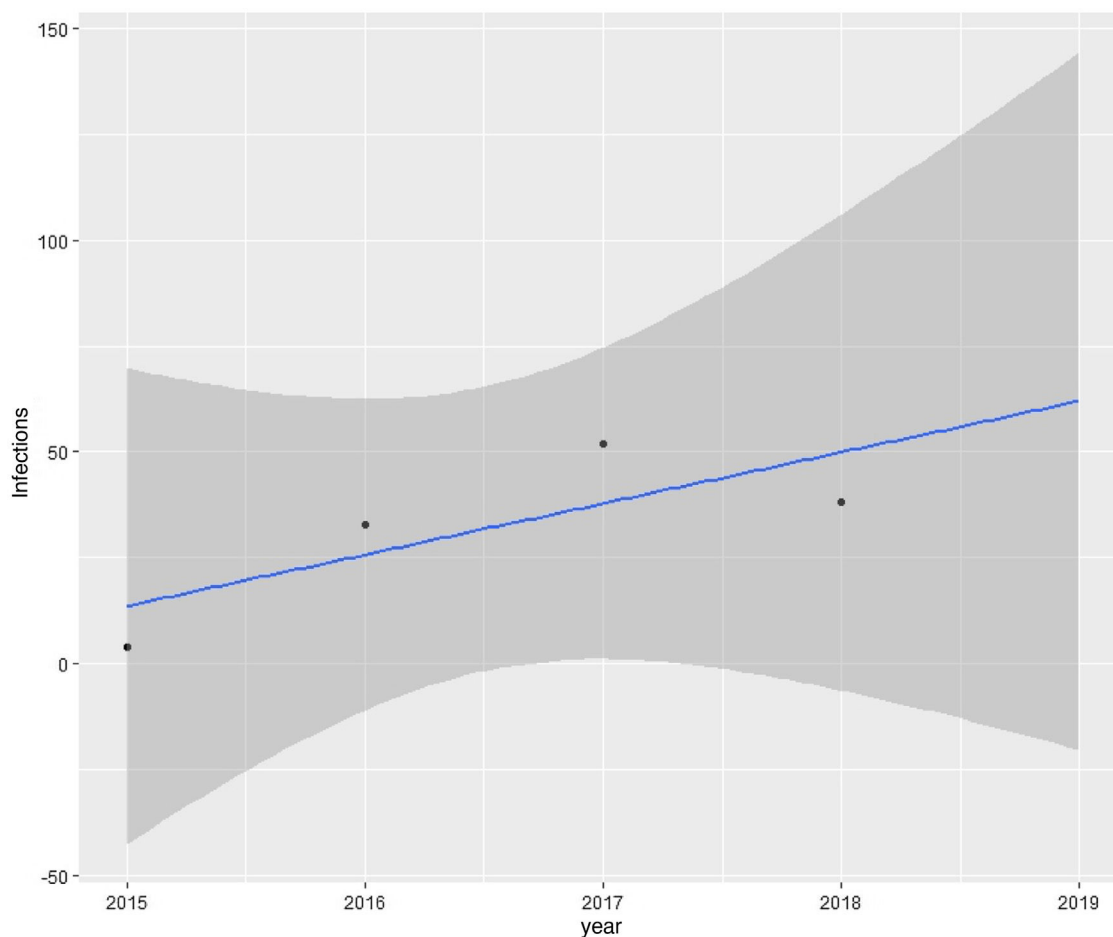


Figure 1. Infectious disease e-consultations trend with respect to the total per year.

Table 1
Description of the infectious diseases treated.

Diagnosis	No. of cases	Evacuations	Mortality	Africa	Europe	Naval	Middle East
Acute pharyngotonsillitis	26 (20.47%)	–	–	9	2	15	–
Malaria	14 (11.02%)	7 (50%)	1 (7.14%)	5	–	9	–
Respiratory infection	13 (10.23%)	4 (30.76%)	–	8	1	4	–
Otitis	9 (7.08%)	1 (11.11%)	–	4	2	2	1
Urine infection	9 (7.08%)	–	–	1	2	6	–
Traveller's diarrhoea	8 (6.29%)	1 (12.5%)	–	5	–	2	1
Lower limb cellulitis	8 (6.29%)	–	–	3	1	3	1
Epididymitis	7 (5.51%)	1 (14.28%)	–	2	–	3	2
Viral infection*	6 (4.72%)	2 (33.33%)	–	–	–	3	3
Oral cavity infection	4 (3.14%)	–	–	–	–	4	–
Other (maximum 2 cases)	23 (18.11%)	2 (8.69%)	–	10	–	10	3
Total	127 (100%)	18 (14.17%)	1 (7.14%)	47 (37.01%)	8 (6.30%)	61 (48.03%)	11 (8.66%)

* VZV, mononucleosis, dog-bite rabies prophylaxis, postvaccinal encephalitis, mumps, undetermined viral infection.

are more prevalent in the scenario handled by Spain. The growth trend at the time of consulting may be related to the awareness of the importance of consulting for symptoms of infectious aetiology, since its specific weight, in the case of developing disease, is important and alters the normal functioning of the mission.

Physicians specialising in Internal Medicine were the highest in demand. This can be explained by the fact that this specialisation brings together professionals dedicated to infectious diseases and frequently consulted for this purpose in the hospital setting.¹²

Those in Africa and those aboard ships accounted for 85% of e-consultations. In Africa, the tropical climate conditions added to the presence of vectors explain these findings, which are complemented by the diagnoses obtained from naval ships, which are

mainly deployed in tropical regions. This provides information on how the coexistence of a large number of people in a small space can be a breeding ground for infectious diseases.

Malaria was diagnosed on a ship in 9 of 14 cases. The primary infection may be related to a situation where the ship is moored, but the symptoms that led to diagnosis occurred at sea and thus we see the importance of having access to infectious disease specialists, for better treatment and evolution of a disease that can be life-threatening, demonstrated by the only case of mortality in the sample. Diagnosis is carried out by rapid diagnostic tests in the field. Both the thick smear and other microbiological diagnoses that are necessary to identify the causative pathogen are carried out in support hospitals to which the samples are sent.

The role of TM as a tool to discern the need or not for evacuation has been shown to be vital. Hwang et al.¹³ conducted a review of dermatology e-consultations (2004–2012). They found that TM is an effective tool to avoid unnecessary medical evacuations, and to support or decide on a series of necessary evacuations that would otherwise have been delayed.

The current epidemiological situation highlights the importance of the application of TM,¹⁴ and it is necessary to direct this tool to more diverse groups (not only military), such as populations with limited access to a tertiary hospital. With the SARS-CoV-2 pandemic, it is essential to provide patients with adequate clinical guidance and regulate hospital healthcare flows, so that health systems can withstand the healthcare pressure of the times we live in.¹⁵

Currently, this study, the first of a displaced Spanish population, is a touchstone for promoting the application of TM in infectious diseases in the coming years.

Conclusions

Our paper highlights that infectious diseases benefit from the application of TM, especially in the military field, as it is an important tool for their diagnosis and treatment. This is the first study of these characteristics in Spain, and opens the way for more effective prevention policies. It is a valid model for developing a public health programme for access to remote populations (non-military displaced persons, for example volunteering and international cooperation).

Conflicts of interest

None of the authors have any conflicts of interest.

References

1. Strehle EM, Shabde N. One hundred years of telemedicine: does this new technology have a place in paediatrics? *Arch Dis Child* [Internet]. 2006;91(12):956–9. Available from: <http://adc.bmj.com/cgi/doi/10.1136/adc.2006.099622>
2. World Health Organization Global Observatory for eHealth. Telemedicine: opportunities and developments in member states. Observatory [Internet]. 2010;2:96. Available from: <http://www.who.int/goe/publications/goe.telemedicine.2010.pdf>
3. Gras G. Use of telemedicine in the management of infectious diseases. *Med Mal Infect* [Internet]. 2018;48(4):231–7. Available from: <https://doi.org/10.1016/j.medmal.2018.01.005>
4. Palau E. Telemedicina, e-Salud y enfermedades infecciosas. *Enferm Infecc Microbiol Clin* [Internet]. 2001;19(4):145–7. [http://dx.doi.org/10.1016/S0213-005X\(01\)72593-1](http://dx.doi.org/10.1016/S0213-005X(01)72593-1). Available from: .
5. Eron L, King P, Marineau M, Yonehara C. Treating acute infections by telemedicine in the home. *Clin Infect Dis an Off Publ Infect Dis Soc Am*. 2004;39(8):1175–81.
6. Assimacopoulos A, Alam R, Arbo M, Nazir J, Chen D-G, Weaver S, et al. A brief retrospective review of medical records comparing outcomes for inpatients treated via telehealth versus in-person protocols: is telehealth equally effective as in-person visits for treating neutropenic fever, bacterial pneumonia, and infected bacterial wounds? *Telemed J E Health*. 2008;14(8):762–8.
7. AFHSC. Medical evacuations from Operation Iraqi Freedom/Operation New Dawn, active and reserve components, U.S. Armed Forces, 2003–2011. *MSMR* [Internet]. 2012;19(2):18–21. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22372753>
8. Hillán García L, Setién Dodero F, Del Real Colomo A. El Sistema de Telemedicina Militar en España: una aproximación histórica. *Sanid Mil* [Internet]. 2014;70(2):121–31. Available from: http://scielo.isciii.es/pdf/sm/v70n2/historia_humanidades.pdf
9. Scheid P, Lam DM, Thömmes A, Zöller L. Telemicrobiology: a novel telemedicine capability for mission support in the field of infectious medicine. *Telemed J E Health* [Internet]. 2007;13(2):108–17. Available from: <https://doi.org/10.1089/tmj.2007.0043>
10. Murray CK, Yun HC, Markelz AE, Okulicz JF, Vento TJ, Burgess TH, et al. Operation united assistance: infectious disease threats to deployed military personnel. *Mil Med*. 2015;180(6):626–51.
11. Lappan CM. The US army medical department email teleconsultation program. *US Army Med Dep J*. 2016;2–16:140–7.
12. Nicolle LE, Uhanova J, Orr P, Kraut A, Van Ameyde K, Dow G. Infectious diseases on a general internal medicine clinical teaching unit. *Can J Infect Dis*. 1999;10(1):33–8.
13. Hwang JS, Lappan CM, Sperling LC, Meyerle JH. Utilization of telemedicine in the U.S. military in a deployed setting. *Mil Med*. 2014;179(11):1347–53.
14. Loeb AE, Rao SS, Ficke JR, Morris CD, Riley LH, Levin AS. Departmental experience and lessons learned with accelerated introduction of telemedicine during the COVID-19 crisis. *J Am Acad Orthop Surg*. 2020;28(11):e469–76.
15. Guisado-Clavero M, Ares-Blanco S, Ben Abdellah LD. Using mobile applications and websites for the diagnosis of COVID-19 in Spain. *Enferm Infecc Microbiol Clin* [Internet]. 2020. Available from: <https://doi.org/10.1016/j.eimc.2020.08.002> S0213-005X(20)30267-6, Epub ahead of print. PMID: 33008680; PMCID: PMC7480356.4.