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# Skin and soft-tissue infections: Factors associated with mortality and re-admissions

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ABSTRACT

*Introduction:* Skin and soft-tissue infections (SSTIs) are common and are linked to a wide variety of clinical conditions. Few studies have analysed the factors associated with mortality and re-admissions in medical patients with SSTIs. Accordingly, this study sought to describe the clinical and microbiological characteristics of patients diagnosed with SSTIs, and identify mortality and re-admission related factors.
*Patients and methods:* A total of 308 patients were included in the study. Clinical, socio-demographic and microbiological characteristics were collected. Univariate and logistic regression multivariate analyses were performed in order to identify factors associated with mortality and re-admission.
*Results:* The bacteria responsible were identified in 95 (30.8%) patients, with gram-positive bacteria being isolated in 67.4% and gram-negative in 55.8% of cases. Multi-resistant bacteria were frequent (39%), and the initial empirical treatment proved inadequate in 25.3% of all cases. In-hospital mortality was 14.9%; the related variables were heart failure (OR = 5.96; 95%CI: 1.93–18.47), chronic renal disease (OR = 6.04; 95%CI: 1.80–20.22), necrotic infection (OR = 4.33; 95%CI: 1.26–14.95), and inadequate empirical treatment (OR = 44.74; 95%CI: 5.40–370.73). Six-month mortality was 8%, with the main related factors being chronic renal disease (OR: 3.03; 95%CI: 1.06–8.66), and a Barthel Index score of under 20 (OR: 3.62; 95%CI: 1.17–11.21). Re-admission was necessary in 26.3% of cases, with the readmission-related variables being male gender (OR: 2.12; 95%CI: 1.14–3.94), peripheral vascular disease (OR: 3.05; 95%CI: 1.25–7.41), and an age-adjusted Charlson Comorbidity Index score of over 3 (OR: 3.27; 95%CI: 1.40–7.63).
*Conclusions:* Clinical variables such as heart failure, chronic renal disease, peripheral vascular disease, and necrotic infection could help identify high-risk patients. The main factor associated with higher mortality was inadequate initial empirical treatment. Physicians should consider gram-negative, and even extended-spectrum beta-lactamase-producing bacteria when assigning initial empirical treatment for SSTIs, especially in healthcare-associated cases.



## Infecciones de piel y partes blandas: factores asociados a mortalidad y reingreso

*Palabras clave:*
Infecciones de piel y partes blandas
Infecciones asociadas a los cuidados sanitarios
Bacterias productoras de BLEE
Mortalidad
Reingreso

RESUMEN

*Introducción:* Las infecciones de piel y partes blandas (IPPB) son frecuentes y se asocian a una amplia variedad de presentaciones clínicas. Los factores asociados a mortalidad y reingreso en pacientes con IPPB han sido poco estudiados hasta ahora. En este sentido, el objetivo del presente trabajo es describir las características clínicas y microbiológicas de pacientes diagnosticados de IPPB e identificar factores asociados a mortalidad y reingreso en ellos.
*Pacientes y métodos:* Fueron incluidos un total de 308 pacientes. Se realizó una descripción de las características clínicas, sociodemográficas y microbiológicas. Se llevaron a cabo análisis uni y multivariantes de regresión logística para identificar factores asociados a mortalidad y reingreso en pacientes con IPPB.

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*Resultados:* Los microorganismos responsables fueron identificados en 95 (30,8%) pacientes, de ellos el 67,4% presentaban bacterias grampositivas y el 55,8%, gramnegativas. La presencia de bacterias multirresistentes fue frecuente (39%) y el tratamiento empírico fue inadecuado en el 25,3% de los casos. La mortalidad intrahospitalaria fue del 14,9% y las variables asociadas a ella fueron la insuficiencia cardiaca (OR = 5,96; IC 95%: 1,93-18,47), la insuficiencia renal crónica (OR = 6,04; IC 95%: 1,80-20,22), la infección necrótica (OR = 4,33; IC 95%: 1,26-14,95) y el tratamiento antibiótico empírico inadecuado (OR = 44,74; IC 95%: 5,40-370,73). La mortalidad a 6 meses fue del 8%, y los principales factores asociados, la insuficiencia renal crónica (OR = 3,03; IC 95%: 1,06-8,66) y una puntuación en el índice de Barthel inferior a 20 puntos (OR = 3,62; IC 95%: 1,17-11,21). Reingresaron durante el seguimiento a 6 meses el 26,3% de los pacientes; las variables asociadas a este hecho fueron el sexo masculino (OR = 2,12; IC 95%: 1,14-3,94), la enfermedad vascular periférica (OR = 3,05; IC 95%: 1,25-7,41) y una puntuación en el índice de Charlson ajustado por edad superior a 3 puntos (OR = 3,27; IC 95%: 1,40-7,63).
*Conclusiones:* Variables clínicas como la insuficiencia cardiaca, la insuficiencia renal crónica, la enfermedad vascular periférica y la infección necrótica podrían ayudar a identificar pacientes con IPPB de alto riesgo. El principal factor asociado a una mayor mortalidad fue el tratamiento antibiótico empírico inadecuado. Debería considerarse la posibilidad de que bacterias gramnegativas, o incluso enterobacterias productoras de betalactamasas de espectro extendido, sean las responsables de IPPB, sobre todo en casos asociados a los cuidados sanitarios, a la hora de plantear el tratamiento antibiótico empírico en estos pacientes.


## Introduction

Skin and soft-tissue infections (SSTIs) include a wide variety of epidermis, dermis, subcutaneous tissue and muscle infections. They commonly present with a broad spectrum of clinical manifestations, ranging from mild to life-threatening forms.[1] Gram-positive microorganisms, and *Staphylococcus aureus* in particular, usually cause SSTIs, though gram-negative bacteria and anaerobes may also be implicated.[2,3] In most cases, the specific pathogen responsible cannot be identified, due to the low efficiency of microbiological cultures.[4] These diseases are commonly diagnosed in emergency wards[5] as well as among hospitalised[1,6] and critically ill patients,[7] with incidence being seen to rise in recent years.[6]

It is essential to consider the clinical characteristics of these patients (diabetes mellitus, obesity, vascular disease, traumatism, recent surgery) and/or the possible existence of immunocompromised status [human immunodeficiency virus infection, immunosuppressive therapy, advanced age], because of the potential role that these factors may play in predisposition to SSTI development and worse disease progression.[4] In this regard, there are few studies that describe clinical factors linked to SSTI development, and fewer still in the case of variables associated with higher mortality and readmission.[1,8] Moreover, most of previous series describe cases from both medical and surgical departments, whose characteristics could be quite different.[1,8]

The dual aim of this study was thus: to analyse the epidemiological, clinical, analytical and microbiological characteristics potentially linked to SSTIs in medical patients; and to identify the factors associated with higher mortality and readmission.

## Patients and methods

We conducted a retrospective analysis which covered all patients diagnosed with SSTIs at the Internal Medicine Department of the Santiago de Compostela University Teaching Hospital (*Complejo Hospitalario Universitario de Santiago*) (NW Spain), from 1 October 2010 to 31 December 2013, as shown by the hospital discharge database. This search included all patients identified with the following ICD 10 (International Classification of Diseases, 10th edition) codes: 680.*; 681.*; 682.*; 683.*; 686.*; 035.* and 785.*. The diagnosis criteria followed to include patients and classify them into the different type of SSTIs were those published in current guidelines.[9]

Through patients' medical histories review, we first exclude all patients who did not met SSTIS criteria.[9] After that, we recorded their socio-demographic, clinical and analytical characteristics, and then followed them up for six months post-discharge. We evaluated and quantified case complexity using the age-adjusted Charlson Comorbidity Index (CCI),[10] and established patients' grade of physical dependence using the Barthel Index (BI).[11]

Cases were classified as follows: nosocomial, where diagnosis had been established later than the second day after hospital admission; and healthcare-associated, in those instances where they had come from nursing homes, been hospitalised, or been treated with intravenous antibiotics during the 90 previous days. All other cases were identified as community-acquired.

We considered as fever a corporal temperature higher than 37.8 °C and sepsis was defined according to the Surviving Sepsis Campaign criteria, current during the study period.[12] Empirical antibiotic treatment was deemed inadequate in the following cases: if the first administered antibiotic proved ineffective for the isolated bacteria after culture (microbiological criteria); or if it was changed due to therapeutic failure during the first 72 h, based on clinical criteria.

All patients deceased during their hospitalisation were included as in-hospital mortality. A 6-month follow up was made in all survivors; in those cases mortality and readmission by any cause were recorded and also specific SSTIs-related mortality and readmission.

A descriptive analysis was performed, by calculating qualitative-variable rates plus mean and standard deviation. We used the Chi-square test or Fisher's exact test, as appropriate (expected frequency value <5), to compare qualitative variables, and the Student's t test for quantitative variables. A multivariate logistic regression analysis was conducted to identify factors associated with mortality and readmission. Akaike's information criterion (AIC), which combines the goodness of fit with the number of parameters, was used to select the best model.[13] The model with the lowest AIC value was considered to have the best fit. A *P*-value <0.05 was regarded as significant. All analyses were performed using the SPSS v. 22.0 software package (SPSS Inc., Chicago, IL, USA).

## Results

During the study period, there was a total of 308 patients with SSTIs, 50.6% men, mean age 71.3 years (standard deviation [SD] = 16.2). In 11.2% of cases, BI scores were less than 20, indicating a severe degree of physical dependence. All patients' histories

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