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# Infection is the leading cause of hospital mortality in patients with dermatomyositis/polymyositis: data from a population-based study

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## Abstract

**OBJECTIVE—**Dermatomyositis (DM) and polymyositis (PM) are debilitating inflammatory myopathies associated with significant mortality. We evaluated the relative contribution of infection to hospital mortality in a large population-based study of individuals with DM/PM.

**METHODS—**Data derive from the 2007 to 2011 Healthcare Cost and Utilization Project National Inpatient Samples and included all hospital discharges that met a validated administrative definition of DM/PM. The primary outcome was hospital mortality. Variables for infections and comorbidities were generated from discharge diagnoses using validated administrative definitions. Logistic regression was used to investigate the relationship between infection and mortality in individuals with DM/PM, adjusting for sociodemographics, utilization variables, and comorbidities. Relative risks were calculated to compare the overall prevalence of specific infections and associated mortality in DM/PM hospitalizations with those seen in the general hospitalized population.

**RESULTS—**15,407 hospitalizations with DM/PM met inclusion criteria for this study and inpatient mortality was 4.5% (700 deaths). In adjusted logistic regression analyses, infection (OR 3.4, 95% CI 2.9–4.0) was the strongest predictor of hospital mortality among individuals with DM/PM. Bacterial infection (OR 3.5, 95% CI 3.0–4.1), comprised primarily of pneumonia and bacteremia, and opportunistic fungal infections (OR 2.5, 95% CI 1.5–4.0) were independently associated with hospital mortality. The overall burden of infection in hospitalizations with DM/PM was significantly increased in comparison with the general hospitalized population (RR 1.5, 95% CI 1.4–1.6).

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**CONCLUSION—**Among hospitalized individuals with DM/PM, infection is the leading cause of mortality. Strategies to mitigate infection risk in both the clinic and hospital settings should be evaluated to improve disease outcomes.

Dermatomyositis (DM) and polymyositis (PM) are debilitating inflammatory myopathies characterized by the subacute onset of symmetric proximal muscle weakness (1). DM/PM are associated with considerable mortality, with ten-year survival most recently estimated to be 53–91% (2–5). Infection has been described as one of the leading causes of mortality in patients with DM/PM (2,3,6,7).

Given the rarity of the diseases, few studies have evaluated the burden of specific infections in patients with DM/PM. Most recently, a retrospective study reported that 37% of 279 consecutive patients with DM/PM experienced severe infections. Of patients who developed an infection, 68% were bacterial, primarily pneumonia, and 36% were attributable to opportunistic infection (fungal, viral, and mycobacterial) (8). Likewise, a smaller review of 192 patients with DM/PM found that the frequency of infection was high (28%) and was associated with a poor prognosis (9). Although these studies suggest that infection causes significant morbidity in DM/PM, there have not been large population-based studies to evaluate the burden of severe infections in these diseases or to examine the association with mortality.

We sought to evaluate the relative contribution of infection to mortality in adult individuals with DM/PM in a large population-based study of hospital discharges. Specifically, we assessed the burden of mortality from infection in comparison to other established causes of mortality in DM/PM, as well as the burden of mortality attributable to selected bacterial, opportunistic, mycobacterial, and viral infections. Finally, we characterized the relative prevalence of specific infections and associated mortality in hospitalizations with DM/PM in comparison with the general hospitalized population.

## METHODS

### Data source and study population

Data were derived from the Healthcare Cost and Utilization Project Nationwide Inpatient Sample (NIS). The NIS is a stratified, nationally representative sample containing 20% of all nonfederal, short-term hospital discharges in the United States. It contains demographic, clinical and resource-utilization information abstracted from hospital discharge summaries. Diagnoses were derived from International Classification of Disease-9 Clinical Modification (ICD-9) codes, and include one primary and up to 24 secondary discharge diagnoses.

We identified all hospital discharges from 2007 to 2011 for individuals over the age of 18 with a diagnosis of DM (710.3) or PM (710.4) as a primary or any secondary diagnoses. ICD-9 codes for DM and PM have been previously validated for use with administrative data (10). Hospitalizations were excluded if they had an ICD-9 code related to pregnancy for that hospitalization or were missing a covariate of interest. For comparison with the general hospitalized population, we identified all hospital discharges from 2007 to 2011 for individuals over the age of 18 and took a random 0.1% sample, excluding individuals with a

diagnosis of DM/PM (n=15), again excluding those with an ICD-9 code related to pregnancy or those missing covariates of interest.

## Outcomes and covariates

Mortality was the primary outcome in this study and was defined as any hospitalization in which the individual died prior to discharge. We categorized causes of mortality in DM/PM based on validated definitions used in the literature. Malignancy was defined using previously defined ICD-9 codes for Charlson comorbidities “any malignancy” and “metastatic solid tumor,” and cardiovascular disease (CVD) was defined using previously defined codes for “myocardial infarction,” “congestive heart failure,” “peripheral vascular disease,” and “cerebrovascular disease” (11). Interstitial lung disease (ILD) was defined using codes 515, 516.3, 516.8, and 516.9 as previously described (12). A maximally inclusive all-infections variable was defined by any of the specific infections described below.

Bacterial infections, including meningitis, encephalitis, cellulitis, endocarditis, pneumonia, pyelonephritis, septic arthritis, osteomyelitis, and bacteremia were defined using a previously validated set of ICD-9 codes (13,14). Opportunistic fungal infections were defined using codes for candidiasis, cryptococcus, aspergillosis, and histoplasmosis (117.3, 484.6, 112.5, 112.81, 112.83, 112.84, 114, 117.5, 321.0, and 115), as previously described(14,15). However, conditions included in the previously described algorithm that generally represent colonization, including pulmonary candidiasis and allergic bronchopulmonary aspergillosis, were excluded to improve the specificity of this variable. Mycobacterial infections were defined by ICD-9 codes for tuberculosis (010.x–018.x) and non-tubercular mycobacterium (031.x) (13). Viral infections included herpes zoster (VZV, 053.x), herpes simplex (HSV, 054.x) and cytomegalovirus (CMV, 078.5) (16,17).

We included other clinically relevant covariates in our analysis. Sociodemographic variables included age, gender, race/ethnicity (white, African American, Hispanic, other, and missing) and low income (residing in ZIP code with median income in the bottom quartile). A “missing” category was included for race because it is not specified in approximately 10% of hospital discharges from the NIS. We identified whether the underlying diagnosis was DM (710.3) or PM (710.4). A modified Charlson Index was calculated for each individual as previously described; however, we excluded clinical variables from this index that were included individually in analyses (11). Utilization characteristics included non-elective admission, transfer from another acute care hospital, and length of stay (LOS).

## Statistical Analyses

We performed unadjusted logistic regressions in which the primary outcome was mortality during hospitalization among individuals with DM/PM, and predictors were either the known causes of mortality in myositis (ILD, CVD, malignancy, and infection) or utilization variables (non-elective admission, transfer from another hospital, and LOS). An adjusted analysis including all of these variables also controlled for sociodemographic variables described above. To evaluate specific infections, we performed unadjusted logistic regressions for selected bacterial, opportunistic fungal, mycobacterial, and viral infections.

A multivariate regression including these categories was then adjusted for sociodemographic, utilization, and other clinical variables.

To determine the relative prevalence of infection, comparisons were conducted between hospitalizations with DM/PM and the general hospitalized population for each specific infection by calculating relative risks with 95% confidence intervals. To determine whether mortality was increased in individuals with DM/PM with specific infections relative to the general hospitalized population with the respective infections, we again calculated relative risks.

To address the fact that 16% of hospitalizations were missing the race/ethnicity of individuals, we performed sensitivity analyses. We assumed all hospitalizations with missing race/ethnicity were among white individuals, then all among African American individuals, and finally excluded all hospitalizations with missing race/ethnicity information. We tested for interactions between infection and ILD as well as between categories of infection (specific bacterial, opportunistic fungal, mycobacterial, and viral). All variables were tested for non-collinearity. We also performed analyses with the entire hospitalized cohort to ensure the 0.1% sample was truly representative.

## Results

We identified 15,844 hospital discharges between 2007 and 2011 in the NIS for DM/PM among individuals over the age of 18 and without pregnancy-related diagnoses. Of those hospitalizations, 437 (3%) were excluded because they were missing one or more covariates of interest: 7 were missing age, 9 were missing gender, 381 were missing income, 47 were missing whether admission was elective, and 1 was missing LOS. 15,407 hospitalizations for individuals with DM/ PM contained information pertaining to all covariates of interest and were included in the analysis. In sensitivity analyses for race, all models yielded highly comparable results, so hospitalizations missing race were included with race defined as “missing” to maximize the power of this study. 700 (4.5%) individuals with DM/PM died prior to discharge.

From the sample of 28,861 hospitalizations from the general hospitalized population over the age of 18 and without pregnancy-related diagnoses, 871 were excluded because they were missing one or more covariates of interest, and 15 hospitalizations were excluded because they had a diagnosis of DM/PM as their primary or any of their secondary diagnoses. 27,990 hospital discharges contained information pertaining to all covariates of interest in the general hospitalized patient population sample, of whom 726 (2.6%) died prior to discharge.

Characteristics of hospitalizations are displayed in Table 1. Of 15,407 hospital discharges with DM/PM, the mean age was 61 years and 68% were female. 50% of hospitalizations were among whites, 21% were among African Americans, and 8% were among Hispanics. This differed from the rates seen among all hospitalizations in which 60% were white and only 12% were among African Americans. 28% of hospitalizations were in individuals who

lived in areas with median income in the lowest quartile. 65% of hospitalizations were associated with a diagnosis of DM while 35% were associated with a diagnosis of PM.

Characteristics of individuals with DM/PM who survived and died and regression analyses evaluating predictors of hospital mortality are displayed in Table 2. 60% of individuals who died carried a diagnosis of infection in comparison to only 26% of individuals who survived to discharge. All utilization variables and clinical variables, including ILD, infection, malignancy, and CVD were significantly associated with mortality in unadjusted models. Likewise, non-elective admission (OR 1.7, 95% CI 1.3–2.2) and transfer from another hospital (OR 1.8, 95% CI 1.3–2.3) were both independent predictors of hospital mortality in the adjusted model, as was longer LOS (OR 1.0, 95% CI 1.0–1.1) though marginally so. Furthermore, ILD (OR 1.8, 95% CI 1.5–2.3), infection (OR 3.4, 95% CI 2.9–4.0), malignancy (OR 2.9, 95% CI 2.3–3.6), and CVD (OR 1.9, 95% CI 1.6–2.2) all significantly predicted hospital mortality in the adjusted model, with the greatest odds of death seen in infection.

The prevalence of specific infections among hospitalized individuals with DM/PM is shown in Table 3. Individuals with DM/PM who died were significantly more likely to have a bacterial infection (58% vs. 24%, OR 4.3, 95% CI 3.6–5.1), specifically pneumonia (33% vs. 13%, OR 3.4, 95% CI 2.9–4.1) or bacteremia (41% vs. 7%, OR 9.1, 95% CI 7.7–10.7) compared with those who survived in unadjusted analyses. Individuals with DM/PM who died were also significantly more likely to have an opportunistic fungal infection than those who survived to discharge (3% vs. 1%, OR 3.3, 95% CI 2.1–5.1). An adjusted logistic regression comparing pathogen-specific categories of infection is also shown in Table 3. Bacterial infection (OR 3.5, 95% CI 3.0–4.1) and opportunistic fungal infection (OR 2.5, 95% CI 1.5–4.0) remained independently associated with mortality in DM/PM. There were no identifiable interactions between infection and ILD, or between categories of infection (specific bacterial, opportunistic fungal, mycobacterial, and viral).

The prevalence of specific infections among hospitalizations with DM/PM in comparison with the general hospitalized population is shown in Table 4. Hospitalizations with DM/PM were significantly more likely to carry a diagnoses of any infection (RR 1.5, 95% CI 1.4–1.6) and were significantly more likely to have any bacterial infection (RR 1.4, 95% CI 1.4–1.5) compared to hospitalizations without DM/PM. The majority of specific infections examined were also more common among DM/PM hospitalizations (see Table 4).

Finally, the mortality associated with specific infections in hospitalizations with DM/PM in comparison with the general hospitalized population is shown in Table 4. Among individuals who carried a diagnosis of any infection, those with DM/PM were more likely to die than individuals in the general hospitalized population (RR 1.4, 95% CI 1.2–1.6). Of the specific bacterial infections, individuals with DM/PM had a higher risk of death than individuals in the general hospitalized population with cellulitis (RR 1.8, 95% CI 1.1–2.8), pneumonia (RR 1.3, 95% CI 1.1–1.5), and bacteremia (RR 1.3, 95% CI 1.2–1.6).

## Discussion

In this large, nationwide study, infections were the strongest predictor of mortality among hospitalized individuals with DM/PM, with a 4.2 fold increase in the odds of death. In particular, pneumonia, bacteremia, and opportunistic fungal infections were significantly associated with mortality. The majority of bacterial, opportunistic fungal, mycobacterial, and viral infections occurred at a higher rate in hospitalizations with DM/PM in comparison with the general hospitalized population. Our findings extend previous work demonstrating that individuals with DM/PM are at significantly increased risk for severe infections. While the majority of life-threatening infections in DM/PM individuals were bacterial in nature (namely, pneumonia and bacteremia), rates of opportunistic fungal infections were also increased in these individuals and significantly associated with mortality.

Previous work has found increased hospital mortality among DM/PM individuals in association with CVD, ILD, malignancy, and infection. However, the relative contribution of these factors has been variable across studies (2,3,6,7). Patients with DM/PM are at increased risk for pneumonia due to multiple factors, including chronic immunosuppression, respiratory disease, and digestive complications that increase the risk of aspiration (8). In a review of 279 patients, Marie et. al found that patients with manifestations including muscle weakness, dysphonia, esophageal dysfunction, and respiratory muscle weakness were all at increased risk for infection (8). While pneumonia may be related to the physiology of the disease, the increased rate of bacteremia is likely, at least in part, related to immunosuppression. In Marie et al.'s study, methotrexate, azathioprine, infliximab, and higher daily doses of steroids increased susceptibility to infection (8). Sepsis has become an increasingly challenging issue in our hospitals in general, and the association between bacteremia and mortality in DM/PM may be reflective of this trend. For example, in a study evaluating trends in hospitalization and mortality for severe sepsis between 1993 and 2003, authors found that the rate of severe sepsis had doubled and overall mortality from severe sepsis had increased even though case fatality rates had decreased (18). However, while mortality rates from bacteremia were high in all hospitalizations, our study demonstrates that individuals with DM/PM are at significantly increased risk of mortality from bacteremia when compared with the general hospitalized population.

Opportunistic fungal infections were significantly and independently associated with mortality in individuals with DM/PM, and while the rate of fungal infection was relatively low, 3% of individuals with DM/PM who died carried a diagnosis of opportunistic fungal infection. Individuals with DM/PM were at significantly increased risk for opportunistic fungal infections in comparison with the general hospitalized population. Marie et al. also found that their cohort suffered from opportunistic infections, including fungal, mycobacterial and viral infections (8,19). While we also saw an increased rate of mycobacterial and viral infections (including HSV, VZV, and CMV), these did not seem to be associated with mortality among individuals with DM/PM. Part of the minimal mortality seen in association with viral infections in our study may have been definitional, as we did not include JC virus and human herpes virus 8 as part of our viral definition given the rarity of the illnesses and lack of ICD-9 codes validated in administrative data. Likewise, the

ICD-9 codes that we used for tuberculosis and non-tuberculous mycobacterium have widely varying sensitivity and specificity depending on the study (13,14,20–22).

In addition to the clinical variables described above, it is interesting to note that patients hospitalized with myositis were more likely to be African American then patients in the sample of all hospitalizations. This reflects the increased prevalence of myositis among African Americans that has been previously described, though there were not clinically meaningful differences in race associated with mortality in our study (23). Utilizations variables, however, including non-elective admission and transfer from another acute-care facility, were both independently associated with mortality. It is likely that these variables are both, in part, markers of severity of illness. Patients are often electively admitted for planned surgical or medical interventions at a time when their disease is relatively controlled. A large study of 4,569 consecutive patients admitted to a tertiary care intensive care unit found that patients who were transferred from another hospital had significantly greater hospital mortality, but when adjusted for the Acute Physiology and Chronic Health Evaluation (APACHE) III score, mortality was similar indicating that transferred patients were generally more severely ill (24). Furthermore, non-elective admissions are more likely to occur on the weekend than elective admissions, and numerous studies have found trends towards increased mortality with various acute illnesses when admitted on the weekend (25,26).

This is the largest study to date evaluating the contribution of infection to hospital mortality in individuals with DM/PM. However, this study has limitations. While data from the NIS provide us with an unparalleled view of the hospitalized population in the United States due to the systematic sampling of the universe of hospitalizations, administrative data may have diagnosis-dependent misclassification. We suspect that nondifferential misclassification likely resulted in conservative estimates in our study and associations may be more robust in practice. We used the most specific definitions available for infections in order to best characterize risk. For bacterial infections, we used the specific set of definitions from Schneweiss et al., as evaluated by Patkar et al (13,27). For opportunistic infections, we used the ICD-9 codes evaluated by Grijalva et al., but excluded allergic bronchopulmonary aspergillosis and candidiasis of the lung in an attempt to further increase specificity (14,15). Given that clinical definitions in our study were solely based on ICD-9 codes, we did not have access to detailed clinical information, both concerning the underlying disease and the infectious complications; therefore, we are unable to assess the severity of the underlying disease, disease activity, and time since diagnosis which may all affect a patient's predisposition to infectious complications and mortality. Furthermore, not all algorithms for identifying complications using administrative data have been extensively studied. For example, we were surprised that there was no interaction between infection and ILD; one hypothesis is that this is to issues with sensitivity and specificity of the variable for ILD and additional studies are needed to identify the ICD-9 codes that result in the most rigorous variable. Lack of specificity in how ICD-9 codes are entered into discharge abstracts also prohibits more extensive analysis; for example, we are unable to ascertain the specific organisms leading to bacteremia as the majority of bacteremia cases are coded with the ICD-9 code for "unspecified bacteremia." Moreover, there are no laboratory or medication

data available in the NIS, making it impossible to quantify the degree of immunosuppression.

In conclusion, individuals with DM/PM were at significantly increased risk for bacterial, opportunistic fungal, mycobacterial, and viral infection. Bacteremia, pneumonia, and opportunistic fungal infections were significantly associated with hospital mortality. We speculate that this is secondary to underlying immune-dysfunction, respiratory and gastrointestinal manifestations increasing aspiration risk, heavy immunosuppressive use, and the increasing prevalence of severe sepsis in the hospital environment; additional studies are needed to better evaluate the relative contributions of these variables to infection and mortality (1,8,18).

Healthcare providers for patients with DM/PM should consider how to reduce the prevalence and severity of infections in this population. Because our study suggests that patients with myositis are at increased risk of death from bacteremia and pneumonia, ensuring compliance with pneumococcal vaccination is essential. According to 2012 Advisory Committee on Immunization Practices (ACIP) guidelines, immunocompromised adult patients who have not received a pneumococcal vaccine should receive both a single dose of the 13-valent pneumococcal conjugate vaccine (PCV13) as well as a dose of the 23-valent pneumococcal polysaccharide vaccine (PPSV23) at least eight weeks later. If an immunocompromised patient has already received PPSV23, they should receive a single dose of PCV13 at least one year after the last PPSV23 dose. In either case, a second PPSV23 dose is recommended five years after the first PPSV23 dose (28). Future studies are needed to assess whether patients are receiving appropriate vaccination for bacterial infection in practice. Furthermore, while we do not have sufficient data to make suggestions about primary fungal prophylaxis in these patients, additional studies are needed to identify whether patients with DM/PM who are severely immunocompromised may benefit.

Given the increased prevalence of infection and its association with mortality, providers should pay particular attention to infection control practices in patients with DM/PM in both the clinic and hospital settings. Vaccination and anti-microbial prophylaxis, appropriate hospital hygiene, and limiting immunosuppression may all play a role in minimizing infection risk in these patients. In the long-term, treatment strategies that modify the disease course without leading to profound immunosuppression will likely reduce infectious risk and improve outcomes in these patients.

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## SIGNIFICANCE AND INNOVATION

- While current studies indicate that infection causes significant morbidity in dermatomyositis and polymyositis (DM/PM), there have been no large population-based studies evaluating the burden of severe infections and associated mortality in DM/PM.
- Infection was the strongest predictor of mortality among hospitalized patients with DM/PM.
- Pneumonia, bacteremia, and opportunistic fungal infections occurred at a higher rate among hospitalized individuals with DM/PM than in the general hospitalized population and were significantly associated with hospital mortality.

## Table 1

Characteristics of all hospitalizations and hospitalizations with myositis in the National Inpatient Sample

| | Sample of all hospitalizations (n=27,990) | All myositis hospitalizations (n=15,407) | Myositis hospitalizations | |
|---|---|---|---|---|
| | | | *Survived* (n=14,707) | *Died* (n=700) |
| Age | 62+/−19 | 61+/−16 | 60+/−16 | 66+/−15 |
| Female | 15,074 (54%) | 10,534 (68%) | 10,089 (69%) | 445 (64%) |
| Race | | | | |
| White | 16,781 (60%) | 7,719 (50%) | 7,344 (50%) | 375 (54%) |
| African American | 3,307 (12%) | 3,253 (21%) | 3,125 (21%) | 128 (18%) |
| Hispanic | 1,990 (7%) | 1,226 (8%) | 1,172 (8%) | 54 (8%) |
| Other | 1,311 (5%) | 638 (4%) | 597 (4%) | 41 (6%) |
| Missing | 4,601 (16%) | 2,571 (17%) | 2,469 (17%) | 102 (15%) |
| Lowest income quartile | 8,062 (29%) | 4,387 (28%) | 4,216 (29%) | 171 (24%) |
| Charlson Index | 0.9+/−1.2 | 0.9+/−1.1 | 0.9+/−1.1 | 1.2+/−1.3 |
| Dermatomyositis (vs. polymyositis) | NA* | 10,023 (65%) | 9,574 (65%) | 449 (64%) |

* Patients with a discharge diagnosis of 710.3 or 710.4 were excluded from the sample of all hospital discharges (15 patients were excluded from this group).

## Table 2

Predictors of mortality in hospitalizations with myositis: characteristics and logistic regression analyses

| | Prevalence of characteristic | | Unadjusted OR for hospital mortality (95% CI) | Adjusted OR for hospital mortality (95% CI)* |
|---|---|---|---|---|
| | Survived (n=14,707) | Died (n=700) | | |
| Utilization variables | | | | |
| Non-elective admission | 12,020 (82%) | 624 (89%) | **1.8(1.4–2.3)** | **1.7(1.3–2.2)** |
| Transfer from another hospital | 788 (5%) | 74 (11%) | **2.1(1.6–2.7)** | **1.8(1.3–2.3)** |
| Length of Stay (per 2 days) | 3.4+/−4.4 | 6.8+/−10.6 | **1.1(1.1-1.1)** | **1.0(1.0–1.1)** |
| Causes of mortality | | | | |
| Interstitial lung disease | 1,710 (12%) | 133 (19%) | **1.8(1.5–2.2)** | **1.8(1.5–2.3)** |
| Infection (all) | 3,873 (26%) | 420 (60%) | **4.2(3.6–4.9)** | **3.4(2.9–4.0)** |
| Malignancy | 1,099 (7%) | 123 (18%) | **2.6(2.2–3.2)** | **2.9(2.3–3.6)** |
| Cardiovascular disease | 4,288 (29%) | 348 (50%) | **2.4(2.1–2.8)** | **1.9(1.6–2.2)** |

*Regression model adjusts for age, gender, race/ethnicity, income, modified Charlson comorbidity index, and the underlying diagnosis (DM vs. PM). All predictor variables are included in one model.

## Table 3

Mortality associated with specific infections in hospitalizations with myositis

| | Prevalence of infection | | Unadjusted OR for hospital mortality (95% CI) | Adjusted OR for hospital mortality (95% CI)[#] |
|---|---|---|---|---|
| | Survived (n=14707) | Died (n=700) | | |
| *Infection (all)* | *3,873 (26%)* | *420 (60%)* | ***4.2(3.6–4.9)*** | |
| Selected bacterial | 3,548 (24%) | 406 (58%) | **4.3(3.7–5.1)** | **3.5(3.0–4.1)** |
| Meningitis / Encephalitis | 46 (0.3%) | 1 (0.1%) | 0.5(0.1–3.3) | |
| Cellulitis | 959 (7%) | 43 (6%) | 0.9(0.7–1.3) | |
| Endocarditis | 35 (0.2%) | 4 (0.6%) | 2.4(0.9–6.8) | |
| Pneumonia | 1,860 (13%) | 233 (33%) | **3.4(2.9–4.1)** | |
| Pyelonephritis | 107 (0.7%) | 5 (0.7%) | 1.0(0.4–2.4) | |
| Septic arthritis / osteomyelitis | 214 (1%) | 9 (1%) | 0.9(0.5–1.7) | |
| Bacteremia | 1,037 (7%) | 285 (41%) | **9.1(7.7–10.7)** | |
| Opportunistic fungal[*] | 156 (1%) | 24 (3%) | **3.3(2.1–5.1)** | **2.5(1.5–4.0)** |
| Mycobacterial[**] | 76 (0.5%) | 5 (0.7%) | 1.4(0.6–3.4) | 0.7(0.3–2) |
| Viral[***] | 269 (2%) | 16 (2%) | 1.3(0.8–2.1) | 1.0(0.6–1.7) |

[#]Regression model adjusts for age, gender, race/ethnicity, income, modified Charlson comorbidity index, the underlying diagnosis (DM vs. PM), non-elective admission, transfer from another hospital, length of stay, ILD, malignancy, CVD, and other pathogen-specific predictor variables in model; variables in shaded cells were not included.

[*]Opportunistic fungal infections include aspergillus, disseminated candidiasis, coccidioidomycosis, histoplasmosis, and Cryptococcus.

[**]Mycobacterial infections include tuberculosis and non-tuberculous mycobacterium.

[***]Viral infections include HSV, VZV, and CMV.

## Table 4

Prevalence and mortality from specific infections in hospitalizations with myositis as compared to a sample of the general hospitalized population in the National Inpatient Sample

| | ***Prevalence of specific infections (number and percentage of patients with infection)*** | | | ***Mortality among patients with a specific infection (number and percentage of infected patients who died)*** | | |
|---|---|---|---|---|---|---|
| | **Sample of all hospital discharges (N=27,990)** | **Myositis (N=15,407)** | **Relative risk (95% CI)** | **Sample of all hospital discharges** | **Myositis** | **Relative risk (95% CI)** |
| Infection (all) | 5,206 (19%) | 4,293 (28%) | **1.5(1.4–1.6)** | 375 (7%) | 420 (10%) | **1.4(1.2–1.6)** |
| Selected bacterial | 5,024 (18%) | 3,954 (26%) | **1.4(1.4–1.5)** | 371 (7%) | 406 (10%) | **1.4(1.2–1.6)** |
| Meningitis / Encephalitis | 23 (0.1%) | 47 (0.3%) | **3.7(2.3–6.1)** | 3 (13%) | 1 (2%) | 0.2(0–1.5) |
| Cellulitis | 1,415 (5%) | 1,002 (7%) | **1.3(1.2–1.4)** | 34 (2%) | 43 (4%) | **1.8(1.1–2.8)** |
| Endocarditis | 42 (0.2%) | 39 (0.3%) | **1.7(1.1–2.6)** | 2 (5%) | 4 (10%) | 2.2(0.4–11.1) |
| Pneumonia | 2,498 (9%) | 2,093 (14%) | **1.5(1.4–1.6)** | 215 (9%) | 233 (11%) | **1.3(1.1–1.5)** |
| Pyelonephritis | 206 (0.7%) | 112 (0.7%) | 1.0(0.8–1.2) | 5 (2%) | 5 (4%) | 1.8(0.5–6.2) |
| Septic arthritis /osteomyelitis | 291 (1%) | 223 (1.4%) | **1.4(1.2–1.7)** | 4 (1%) | 9 (4%) | 2.9(0.9–9.4) |
| Bacteremia | 1,491 (5%) | 1,322 (9%) | **1.6(1.5–1.7)** | 239 (16%) | 285 (22%) | **1.3(1.2–1.6)** |
| Opportunistic fungal* | 90 (0.3%) | 180 (1.2%) | **3.6(2.8–4.7)** | 10 (11%) | 24 (13%) | 1.2(0.6–2.4) |
| Mycobacterial** | 31 (0.1%) | 81 (0.5%) | **4.7(3.1–7.2)** | 0 (0%) | 5 (6%) | NA |
| Viral*** | 158 (0.6%) | 285 (1.8%) | **3.3(2.7–4.0)** | 4 (3%) | 16 (6%) | 2.2(0.8–6.5) |

* Opportunistic fungal infections include aspergillus, disseminated candidiasis, coccidioidomycosis, histoplasmosis, and Cryptococcus.

** Mycobacterial infections include tuberculosis and non-tuberculous mycobacterium.

*** Viral infections include HSV, VZV, and CMV.