**Patterns of infections in older patients acutely admitted to medical wards: data from the REPOSI register**

# Patterns of infections in older patients acutely admitted to medical wards: data from the REPOSI register

Raffaella Rossio[1], Ilaria Ardoino[2], Carlotta Franchi[2], Alessandro Nobili[2], Pier Mannuccio Mannucci[3], Flora Peyvandi[4,5], REPOSI Investigators

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Dear Editor,

In older adults infections are among the leading causes of emergency department visits, hospitalization, morbidity and mortality [1–3]. Infections also occur as adverse events during hospitalization, as highlighted by the large use of antibiotics in this setting, resulting in an increase of hospitalization length and mortality rate [4–6]. There is a paucity of studies, especially in European countries, that did offer a general pattern on all the types of infections occurring in acutely hospitalized older patients, being the literature mainly focused on single type of infections (i.e. pneumonia and urinary tract infections). To fill this gap of knowledge, we chose to observe and describe the prevalence and types of infections in a large cohort of older hospitalized patients in the frame of REPOSI (REgistro POliterapie SIMI) regis- ter. REPOSI is a collaborative register that involves a large number of Italian internal medicine and geriatric wards. Briefly, patients aged 65 years or more acutely hospitalized during four index periods lasting one week in each season were enrolled and signed an informed consent. The attend- ing physicians were required to compile for each patient a web-based Case Report Form, including the main socio- demographic data, specific diagnoses and their severity according to the Cumulative Illness Rating Scale (CIRS), functional status at hospital admission (measured by Barthel index [BI]) [7] and drug therapies during the whole hospi- talization period. This study was approved by the Ethical Committees of all participating hospitals. More details on REPOSI were provided elsewhere [5, 6].

Patients recruited in the register in 2008, 2010, 2012, 2014 and 2016 were considered for the purpose of this study. Infections were considered when they were the reason for hospitalization, when reported in the CIRS at admission and also when they occurred during the hospital stay, whether reported as a relevant adverse event or as the indication for antimicrobial therapy. Infections were categorized using the International Classification of Diseases-Ninth Edition (ICD-
9) according to the physiological system of origin, on the basis of a classification provided in other studies (Supple- mentary Table 1) [8]. Data were summarized as prevalence (%), or means and standard deviations when pertinent. The 95% confidence intervals (CI) were provided as well. The analysis was performed using the SAS/STAT software Ver- sion 9.2 (SAS Institute Inc., Cary, NC, USA).

Among the 6047 patients enrolled in the REPOSI regis- ter, 2991 (49.5%, 95% CI 48.2–50.7%) were diagnosed with at least one infection, accounting for a total of 3554 infec- tions. Overall 2522 patients (84.3%) had a single infection, 392 (13.1%) two and 77 (2.6%) three or more infections. Almost all the infections had a bacterial or suspected bacte- rial etiology, but 284 (8.0%) were viral, mainly hepatobil- iary (N = 223) and lower-respiratory track (N = 41) infec- tions. Socio-demographic and clinical characteristics of the patients with and without infections are reported in Table 1. A total of 1554 patients (52.0%) were females and their mean age was 80.0 years (SD = 7.5). Compared to patients without infections, almost the same prevalence of females was observed but they were slightly older, the mean age of patients without infections being 78.6 years (SD = 7.4) and they took more medications at hospital admission. While the Barthel index (BI) was not available in the 2008 REPOSI run, in the remaining years patients with infections were often functionally impaired, those with a severe

dependence in daily activities (BI < 49) having a prevalence of 71.5% compared to 28.4% in those without infections. Considering the different years of REPOSI, a substantial increase in the overall prevalence of patients with infections was observed, from 34.0% in the 2008 up to 52.1% in the 2010, with an almost stable prevalence during the following years (with a mean value of 54.5%) (P values < 0.0001 for the overall chi squared comparison and 0.24 for the comparison after excluding the 2008 REPOSI run).

Before admission 187 patients (6.5%) with infections
lived in nursing homes, those from nursing homes being 4.7% less among patients without infections. The greatest number of hospitalizations took place during the winter sea- son, but a slightly higher prevalence of patients with infec- tions was observed during summer (18.2% vs 14.7% in those without infections).

The most common type of infections were in the upper and lower respiratory tract (38.2%), of which 860 were pneu- monia and bronchopneumonia, followed by those in the kid- ney and urinary tract (21.1%) and the hepatobiliary system (9.3%). Bloodstream infections accounted for the 5.5% of the infections (Table 2). An infection was the reason of hospital- ization in 734 patients (24.5%, 95% CI 23.0–26.1%), about half of them being hospitalized for respiratory tract infec- tions, urinary tract and gastrointestinal infections account- ing for 35.0% of the remaining infections. Respiratory tract infections were also the most common infection occurring during hospital stay, followed by those of the urinary tract. When analysing the type of infection over time, there was an almost stable pattern, with an increase only for septicemia (Supplementary Fig. 1). When we analysed infection sites according to sex, urinary (25.5% vs 16.24%) and gastrointes- tinal (8.5% vs 7.2%) infections occurred more frequently in females, hepatobiliary infections in males (10.6% vs 8.0%), and respiratory infections with no marked differences for sex distribution (35.3% in females vs 41.4% in males). Res- piratory tract (35.9% vs 43.4%) and urinary tract infections (20.1% vs 23.4%) were more prevalent among the oldest patients (≥ 85 years), while hepatobiliary infections (10.8% vs 5.9%) were more prevalent in those less than 85 years of age.

Among patients with infections 176 (5.9%) died during hospitalization.

All in all, approximately half of the older patients enrolled in the frame of the REPOSI register (49.5%) had at least one infection diagnosed at admission or during hospital stay, and over the 8-year study period their prevalence remained almost unchanged after an early increase. In Italy, Orlando et al. have previously emphasized as an emerging problem that an increasing number of older people with multiple chronic conditions is admitted to hospital with infections, but actual data on older people acutely hospitalized in medi- cal wards were scanty [9]. In the frame of the different runs of the REPOSI register, respiratory tract infections were the most frequent type of infection being more than one third of the cases (38.2%), followed in prevalence by urinary tract infections throughout all the register runs. The same pat- tern was also observed by others [10]. Septicemia actually increased during the REPOSI runs from 11.3% in 2008 to 24.2% in 2016. This can be explained by an increasing atten- tion for this diagnosis and the large use of artificial devices in older patients.

The patients most frequently hospitalized in internal med-
icine wards are often very old and characterized by multiple chronic conditions, the most frequent concomitant diseases being diabetes and chronic renal failure. Polypharmacy is often a consequence of multimorbidity and indeed at admis- sion more than half of our patients took 5 or more drugs. Other studies identified an association between infections and drug intake and it is known that some drugs frequently prescribed to old people increase the risk of infections [11]. In spite of the fact that a relatively small number of our older patients had a severe or total dependence according to the Barthel index (17.5%), our data support the hypoth- esis that a compromised functional status and polypharmacy are associated with an increased prevalence of infections in the elderly [12]. In the previous studies, a poor

functional status was found to be an independent prognostic factor for mortality in older people with pneumonia and a risk factor for respiratory and urinary tract infections [13, 14]. Fur- thermore, another REPOSI study found that a low Barthel index increased the risk of death in old patients admitted for pneumonia [15]. Finally, there was a lower degree of physical ability in patients with pneumonia developing during hospitalization compared to those admitted with commu- nity acquired pneumonia, as previous reported in a REPOSI study [6]. On the whole, the results of the present study, that considered all types of infections occurring in older people, suggest that a low functional status may be associated with all types of infection, not only with those of the respiratory tract.

There are limitations in this merely descriptive study, such as the fact that the register does not collect details on etiology, outcomes and diagnostic methods for infections (e.g. microbiological cultures, X-ray imaging, etc.). On the other hand REPOSI is based upon data from more than 100 internal medicine and geriatric wards throughout Italy, thus making this study representative of the hospitalized older population of this country. Moreover, data collection started in 2008, so that changes over time were accounted for.

In conclusion infections are frequent events diagnosed in older hospitalized patients with a high number of comorbidi- ties and on polypharmacy, respiratory tract infections being the most frequent followed by urinary tract infections.

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**Compliance with ethical standards**

**Conflict of interest** FP has received honoraria for participating as a speaker at satellite symposia and educational meetings organized by Ablynx, Grifols, Novo Nordisk, Roche, Shire and Sobi. She has re- ceived consulting fees from Kedrion and she is member of the sci- entific advisory board of Ablynx. Other authors have no conflict of interest to declare.

Statements on human and animal rights REPOSI was accepted by the ethical committees of all participant hospitals.

**Informed consent** Each patient supplied informed consent.

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**Table 1 Socio-demographic and clinical characteristics of 2991 older patients with infections and 3056 without infections at hospital admission**

| Variables | Patients with infection *N* (%) | Patients without infections | Missing data |
|---|---|---|---|
| 2008 | 453 (15.2%) | 879 (28.8%) | |
| 2010 | 719 (24.0%) | 661 (21.6%) | |
| 2012 | 703 (23.5%) | 620 (20.3%) | |
| 2014 | 674 (22.5%) | 538 (17.6%) | |
| 2016 | 442 (14.8%) | 358 (11.7%) | |
| Women (*n*, %) | 1554 (52.0%) | 1572 (51.4%) | |
| Age (mean ± SD) | 80 ± 7.5 | 78.6 ± 7.4 | |
| Age group (*n*, %) | | | |
| Young old (≤ 75) | 877 (29.3%) | 1101 (36.0%) | |
| Old (76–84) | 1231 (41.2%) | 1246 (40.8%) | |
| Oldest old ( ≥ 85) | 883 (29. 5%) | 709 (23.2%) | |
| Living arrangement (*n*, %) | | | 219 |
| Alone | 660 (22.8%) | 657 (22.4%) | |
| With family member/caregiver | 2046 (70.7%) | 2140 (72.9%) | |
| Nursing home | 187 (6.5%) | 139 (4.7%) | |
| Barthel index score (*n*, %) | | | 1411 (1332 in 2008) |
| Total dependence (0–24) | 354 (14.2%) | 124 (5.8%) | |
| Severe dependence (25–49) | 229 (9.2%) | 108 (5.1%) | |
| Moderate dependence (50–74) | 345 (13.8%) | 241 (11.3%) | |
| Mild dependence (75–90) | 465 (18.6%) | 403 (18.9%) | |
| Negligible dependence (91–100) | 1108 (44.3%) | 1260 (59.0%) | |
| Number of drugs (*n*, %) | | | |
| 0 | 81 (2.7%) | 113 (3.7%) | |
| 1–4 | 1048 (35.0%) | 1252 (41.0%) | |
| ≥ 5 | 1862 (62.3%) | 1691 (55.3%) | |
| Number of concomitant comorbidities | | | |
| 0 | 25 (0.8%) | 73 (2.4%) | |
| 1–2 | 229 (7.7%) | 351 (11.5%) | |
| 3–4 | 455 (15.2) | 674 (22.0%) | |
| ≥ 5 | 2282 (76.3%) | 1958 (64.1%) | |
| Season of hospitalization (*n*, %) | | | |
| Spring | 800 (26.8%) | 827 (27.1%) | |
| Summer | 544 (18.2%) | 450 (14.7%) | |
| Autumn | 707 (23.6%) | 825 (27%) | |

| Variables | Patients with infection *N* (%) | Patients without infections | Missing data |
|---|---|---|---|
| Winter | 940 (31.4%) | 954 (31.2%) | |
| Associated chronic diseases (*n*, %) | | | |
| Diabetes | 844 (28.2%) | 800 (26.2%) | |
| Heart failure | 504 (16.8%) | 519 (17.0%) | |
| Dementia | 74 (2.5%) | 488 (16.0%) | |
| Parkinson disease | 105 (3.5%) | 428 (14.0%) | |
| Chronic renal failure | 567 (19.0%) | 76 (2.5%) | |
| Cancer | 538 (18.0%) | 38 (1.2%) | |
| Patient status at discharge (*n*, %) | | | 35 |
| Home | 2556 (85.8%) | 2695 (88.9%) | |
| Dead during hospitalization | 176 (5.9%) | 86 (2.8%) | |
| Transferred to another medical ward | 249 (8.4%) | 250 (8.3%) | |

**Table 2 Prevalence of each infection typical in the REPOSI register from 2010 to 2016**

| Type of infection | Number (%) |
|---|---|
| Respiratory tract infections | 1357 (38.2%) |
| Lower | 1074 |
| Upper | 267 |
| Not classified | 16 |
| Gastrointestinal tract infections | 281 (7.9%) |
| Urinary tract infections | 750 (21.1%) |
| Hepatobiliary infections | 330 (9.3%) |
| Cardiac infections | 32 (0.9%) |
| Septicemia | 194 (5.5%) |
| Mycosis | 178 (5.0%) |
| Others | 432 (12.1%) |