Local surveillance study on etiology of community-and hospital-acquired urinary tract infections (UTI) and antimicrobial susceptibility of uropathogens

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SUMMARY
This study was conducted during October 2010-March 2011 with the collaboration of the microbiology laboratory of International Evangelical Hospital (Voltri division) to identify the most frequent pathogens isolates from Urinary Tract Infections (UTI) and to evaluate their antibiotics susceptibility patterns. Overall, 780 consecutive, non duplicate strains were collected and sent to the coordinating laboratory. 143 strains were from Healthcare settings and 637 from community acquired infections. The most represented pathogens was E. coli. In our region the epidemiological community landscape in terms of resistance, is getting closer to the nosocomial setting.

INTRODUCTION
Urinary tract infections (UTIs) are one of the most common infectious diseases (3, 4). UTIs represented a relevant clinical problem because of their frequency and morbidity even if they are associated with a lethality rather low. There is general agreement that, in absence of concomitant risk factors, such as for example advanced age and diabetes, E. coli is the organism most frequently represented.

The etiology of non complicated urinary tract infections is frequently attributed to other Gram negative strains such Proteus spp., Klebsiella spp. and Enterobacter spp.. Gram positive strain such Enterococcus spp. and Staphylococcus spp. are rarely isolated (5, 7).

In recent years has seen a steady increase in levels of resistance to antibiotics most commonly used in the treatment of UTI.

The aim of this local surveillance study was to determine the distribution of bacterial strains isolated from outpatients and inpatients with UTIs and antibiotic susceptibility patterns to antimicrobial agents currently used in the treatment of pathogens causing these infections.

MATERIAL AND METHODS
Bacterial isolates
This study was conducted during October 2010 and March 2011 with the collaboration of the clinical microbiology laboratory of International Evangelical Hospital (Voltri division), Genoa. Overall, 780 consecutive urinoculture isolates were collected and sent to the co-ordinating laboratory (Microbiology Section, DISC, University of Genoa). Strains isolates from in and out-patients were studied, with the exception of duplicate strains from the same patient. Participating laboratory also provided susceptibility data obtained by their routine methods.

RESULTS
Table 1 summaries the complete list and the distribution of the pathogens collected in this study. A total of 780 isolates were found, including 143 and 637 healthcare setting or nosocomial and community acquired infections respectively.

Nosocomial sample
A total of 143 nosocomial sample were collected mainly from patients hospitalized in general medicine wards (47, 32.9%), health care settings (HCS) (33, 23%), neurology (12, 8.4%), neuromotory rehabilitation and ortopedic wards (7, 4.9%), ICU (6, 4.2%), cardiology (5, 3.5%) and other wards (26, 18.2%).

The most represented nosocomial pathogens were: E. coli (71, 49.6%), P. mirabilis (17, 11.9%), Klebsiella spp. (12, 8.4%), other Gram negative (1 C. freundii, 1 C. koseri, 1 E. aerogenes, 2 E. cloaace, 3 M. morganii, 3 P. stuartii, 1 A. baumanii, 3 P. aeruginosa) (15, 10.5%), Enterococcus spp.(5 E. faecium, 13 E. faecalis).

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Carbapenems were the most active molecule against *E. coli* (100% susceptible strains) followed by amikacin (98.6%), piperacillin-tazobactam (74.6%), third generation cephalosporins (62%), amoxicillin-clavulanate, trimethoprim-sulfamethoxazole (53.5%), amoxicillin-clavulanate (50.7%) and ciprofloxacin (46.5%).

All *P. mirabilis* were susceptible to carbapenems, amikacin and piperacillin-tazobactam. 52.9% were susceptible to amoxicillin-clavulanate, trimethoprim-sulfamethoxazole and ciprofloxacin (53.5%), amoxicillin-clavulanate (50.7%) and ciprofloxacin (46.5%).

All the other molecule (third generation cephalosporins, trimethoprim-sulfamethoxazole and ciprofloxacin) showed rate of resistance higher than 80%.

The most active molecule against *Klebsiella* spp. were carbapenems and amikacin (58.3% susceptible strains), followed by piperacillin-tazobactam and third generation cephalosporins and amoxicillin-clavulanate (50%).

The other molecule (trimethoprim-sulfamethoxazole and ciprofloxacin) showed rate of resistance higher than 80%.

The most active molecule against *P. aeruginosa* were carbapenems (100% susceptible strains) followed by amikacin and piperacillin-tazobactam (66.7%). Carbapenems and trimethoprim-sulfamethoxazole (66.7%) showed rate of resistance of 66.7% and the other molecule (third generation cephalosporins and trimethoprim-sulfamethoxazole) were inactive against this pathogens.

The level of vancomycin resistance between *Enterococcus* spp. was 6.3%.

Between 18 community staphylococcus 12 (66.7%) were resistant to methicillin.

**DISCUSSION**

This report described the epidemiology of UTIs isolates in Liguria and their antibiotic susceptibility patterns, evaluating samples from over 780 patient recruited from International Evangelical Hospital (Voltri division) in Genoa. The majority of pathogens were isolated from women (76.5%). It has been extensively reported that adult women have a higher prevalence of UTI acquired

A total of 637 community acquired pathogens were collected. The most rpresented pathogens were: *E. coli* (399, 62.6%), *E. faecalis* (57, 8.9%), *P. mirabilis* (52, 8.2%), *Klebsiella* spp. (436.7%). The other pathogens influence less than 2%.

The most active molecule against *E. coli* were carbapenems (100% susceptible strains), followed by amikacin (99%), piperacillin-tazobactam (91% susceptible strains), third generation cephalosporins (84.5%).

Trimethoprim-sulfamethoxazole, ciprofloxacin and amoxicillin-clavulanate showed rate of susceptibility of 69.4%, 64.2% and 67.4% respectively.

Carbapenems and amikacin were the most effective molecule against *P. mirabilis*, followed by piperacillin-tazobactam (96.3%), third generation cephalosporins (63%) and amoxicillin-clavulanate (59.3%). The other molecule (trimethoprim-sulfamethoxazole and ciprofloxacin) showed a rate of resistance less than 50%.

The most active molecule against *Klebsiella* spp. were carbapenems (100% susceptibility), followed by amikacin (97.7%), piperacillin-tazobactam (93.2%), amoxicillin-clavulanate (86.4%), trimethoprim-sulfamethoxazole and ciprofloxacin (84%) and third generation cephalosporins (81.8%).

All *Pseudomonas* spp. were susceptible to carbapenems and piperacillin-tazobactam, 86.6% were susceptible to amikacin and 84.6% were susceptible to third generation cephalosporins. Ciprofloxacin and trimethoprim-sulfamethoxazole shown rate of resistance of 53.9% and 92.4% respectively.

The level of vancomycin resistance between *Enterococcus* spp. was 6.3%.

Between 18 community staphylococcus 12 (66.7%) were resistant to methicillin.

**Table 1.** Distribution of the strains collected in this survey according to the origin

| Nosocomial | Community | Tot |
|-----------|-----------|-----|
| Num | % | Num | % | Num | % |
| E. coli | 71 | 15.1 | 399 | 84.9 | 470 |
| C. freundii | 1 | 33.3 | 2 | 66.7 | 3 |
| C. koseri | 1 | 50 | 1 | 50 | 2 |
| E. aerogenes | 1 | 8.3 | 11 | 91.7 | 12 |
| E. cloacae | 2 | 22.2 | 7 | 77.8 | 9 |
| K. pneumoniae | 9 | 22.5 | 31 | 77.5 | 40 |
| K. oxytoca | 3 | 20 | 12 | 80 | 15 |
| K. ornithinolytica | 0 | 0 | 1 | 100 | 1 |
| M. morganii | 3 | 37.5 | 5 | 62.5 | 8 |
| P. mirabilis | 17 | 24.6 | 52 | 75.4 | 69 |
| P. rettgeri | 0 | 0 | 2 | 100 | 2 |
| P. stuartii | 3 | 42.8 | 4 | 57.2 | 7 |
| R. ornithinolytica | 0 | 0 | 1 | 100 | 1 |
| R. planticola | 0 | 0 | 1 | 100 | 1 |
| A. baumanii | 1 | 25 | 3 | 75 | 4 |
| P. aeruginosa | 3 | 20 | 12 | 80 | 15 |
| P. fluorescens | 0 | 0 | 1 | 100 | 1 |
| S. aureus | 7 | 50 | 7 | 50 | 14 |
| S. epidermidis | 1 | 20 | 4 | 80 | 5 |
| S. haemolyticus | 1 | 33.3 | 2 | 66.7 | 3 |
| S. hominis | 0 | 0 | 1 | 100 | 1 |
| S. saprophyticus | 0 | 0 | 2 | 100 | 2 |
| S. simulans | 0 | 0 | 2 | 100 | 2 |
| S. agalactiae | 1 | 8.3 | 11 | 91.7 | 12 |
| E. faecium | 5 | 45.5 | 6 | 54.5 | 11 |
| E. faecalis | 13 | 18.6 | 57 | 81.4 | 70 |
| Total | 143 | 18.6 | 630 | 82 | 780 |
than men, principally owing to anatomic and physical factors (8). Similarly to what reported in literature, Enterobacteriaceae dominate in the etiology of UTI also in our region. E. coli was the most representative pathogen isolated from positive UTI (60.3%), with a higher percentage in samples from community patients (62.6%). Antibiotic resistance is a major clinical problem in treating infections caused by these microorganisms. The resistance to the antimicrobials has increased over the years. Resistance rates vary from country to country (1, 6).

For nosocomial E. coli were found percentage of resistance in excess of 20% against third generation cephalosporins, trimethoprim-sulfamethoxazole, ciprofloxacin and amoxicillin-clavulanate. Only carbapenems were completely effective against this pathogens. In community is alarmingly the high incidence of E. coli resistant to fluoroquinolones (more than 30% of resistant strains) and the spread of methicillin resistance in staphylococci (66.7%). In our region the epidemiological community landscape in terms of resistance, is getting closer to the nosocomial setting.

**Table 2.** Distribution of nosocomial strains according to the different clinical settings.

|                  | TOT | CAR | ICU | MED | NEU | ORT | RIAB | HCS | OTH |
|------------------|-----|-----|-----|-----|-----|-----|------|-----|-----|
| E. coli          | 71  | 3   | 2   | 23  | 4   | 4   | 5    | 18  | 12  |
| Other Enterobacteriaceae | 40  | 1   | 1   | 14  | 5   | 3   | 1    | 9   | 6   |
| Non Enterobacteriaceae | 4   | 1   | 1   | 1   | 1   |     | 1    |     |     |
| Stenotococcus spp | 1   |     |     |     |     |     |      |     |     |
| Staphylococcus spp | 9   | 1   | 1   | 5   |     |     | 1    |     |     |
| Enterococcus spp  | 18  | 1   | 4   | 2   | 1   | 4   | 6    |     |     |
| Total            | 143 | 5   | 6   | 47  | 12  | 7   | 7    | 33  | 26  |

CAR, Cardiology; ICU, Intensive Care Units; MED, Medicine; NEU, Neurology; ORT, Orthopedy; RIAB, Rehabilitation; HCS, Healthcare settings; OTH, Other wards (Surgery, Oncology, Pulmonary, Genecology, Nephrology, Infectious disease).

**Table 3.** Percentage of susceptibility in Gram-negative strains to major classes of antibiotics.

|        | CAR | AMK | PZT | CEF III | SXT | CIP | AMC |
|--------|-----|-----|-----|---------|-----|-----|-----|
| E.coli | 100 | 100 | 98.6| 74.6-91 | 62  | 84.5| 53.5|
| Proteus spp | 100 | 100 | 100 | 100 | 96.3 | 17.6| 63 |
| Klebsiella spp | 58.3| 100 | 58.3| 97.7 | 50  | 81.8| 33.3|
| Enterobacter spp | 100 | 100 | 66.7| 94.4 | 0   | 83.3| 0   |
| M.morganii | 100 | 100 | 100 | 100 | 100 | 80  | 60 |
| Citrobacter spp | 100 | 100 | 100 | 100 | 100 | 100 | 66.6|
| Providencia spp | 100 | 100 | 100 | 100 | 100 | 100 | 60 |
| Raoutella spp | 100 | 100 | 100 | 100 | 100 | 100 | 50 |
| Pseudomonas spp | 100 | 100 | 66.7| 86.6 | 66.7| 100 | 50 |
| A.baumannii | 0  | 0   | 0   | 0   | 0   | 0   | 0   |

CAR: carbapenems; AMK: amikacin; PZT: piperacillin-tazobactam; CEF III: third generation cephalosporins; SXT: trimethoprim-sulfamethoxazole; CIP: ciprofloxacin; AMC: amoxicillin-clavulanate.

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