Analysis of the microbial species, antimicrobial sensitivity and drug resistance in 2652 patients of nursing hospital

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\textbf{ABSTRACT}

\textbf{Objective:} To understand the microbial species, antimicrobial sensitivity and drug resistance of patients in the nursing hospital, to bring clinical guiding significance to the use of antimicrobial in the nursing hospital.

\textbf{Methods:} A retrospective analysis of bacterial and drug sensitivity report of 2652 patients in nursing hospitals.

\textbf{Results:} There were 2652 cases of bacterial and drug sensitivity results, including 1202 positive cases, 652 females accounted for 54.24%, and 550 males accounted for 45.76%, concentrated in 70–99 years old. There were 57 kinds of bacteria, 303 cases of Gram-positive bacteria accounted for 25.21%, 808 cases of Gram-negative bacteria accounted for 67.22%, and fungi accounted for 7.57%. The positive samples were mainly from urine (35.94%) and sputum (48.59%). The main Gram-positive bacteria in the positive samples were Staphylococcus aureus (53.14%), Enterococcus faecalis (12.87%), Staphylococcus epidermidis (10.23%), Staphylococcus haemolyticus (6.93%), Enterococcus faecium (3.96%). The main Gram-negative bacteria in the positive samples were E. coli (35.27%), Pseudomonas aeruginosa (20.67%), Klebsiella pneumoniae (13.99%), Proteus mirabilis (8.66%), and Candida albicans (59.34%), Candida albicans (59.34%), Candida albicans (59.34%), Candida albicans (59.34%). Among the Gram-positive bacteria, Enterococcus faecalis and Enterococcus faecalis are easily detected in urine. Staphylococcus haemolyticus and Staphylococcus epidermidis are easily detected in sputum. Staphylococcus aureus is easily detected in sputum and secretions. Among the Gram-negative bacteria, E. coli and Klebsiella pneumoniae are easily detected in sputum and urine. Proteus mirabilis is easily detected in the urine. Pseudomonas aeruginosa and Acinetobacter baumannii are easily detected in sputum. Among the fungi, Candida albicans, Candida albicans, and Candida glabrata are easily detected in sputum. There is a significant statistical difference in the distribution of P. aeruginosa in all age groups. The resistance rate of Staphylococcus aureus to levofoxacin and penicillin are above 90%, the resistance rate to clindamycin and erythromycin are above 80%, the resistance rate to gentamicin is above 70%, and vancomycin and linezolid are not found this time. The resistance rate of E. coli to compound sulfamethoxazole is above 60%, the resistance rate to cefuroxime, cefotaxime, levofoxacin, and ciprofloxacin are above 70%, and the resistance rate to cefazolin is above 80%. The resistance rate to ampicillin is above 90%, the sensitivity rate to nitrofurantoin, minocycline and cefoxitin are above 60%, and the sensitivity to cefepenez sulbactam and piperacillin tazobactam is above 70%. The sensitivity rate of ropamine, imipenem and amikacin are above 80%. The resistance rate of Proteus mirabilis to nitrofurantoin is 100%, the resistance rate to ampicillin are above 90%, and the resistance rate to compound sulfamethoxazole, levofoxacin and ciprofloxacin are above 80%. For cefazolin and gentamicin The rate of resistance is above 70%. The sensitivity rate to cefoxitin, imipenem and amikacin are above 80%, and the sensitivity to meropenem, cefepenez sulbactam, and piperacillin tazobactam are above 90%. Klebsiella pneumoniae to cefazolin, gentamicin, ampicillin, cefoxitin, ceftriaxone, ampicillin sulbactam, compound sulfamethoxazole, levofoxacin, ciprofloxacin are above 80%. The drug resistance rate is above 60%, the sensitivity rate to amikacin is only above 60%, and the sensitivity rate to imipenem and meropenem is only above 50%. Pseudomonas aeruginosa tested resistance to antimicrobial is below 60%, sensitivity to cefazidine, cefepine, meropenem, imipenem, amikacin are above 60%, sensitivity to polymyxin B is above 90%, the sensitivity rate of tigecycline is 100%. The resistance rate of Candida glabrata to...
1. Introduction

According to the basic standards of nursing hospital (2011 edition) published by the Ministry of Health, PRC, the Nursing hospital provides medical care and rehabilitation for long-term hospitalized patients, patients with advanced palliative care, patients with chronically ill, elderly people who cannot take care of themselves or their families, and other patients who need long-term medical care services.

The tasks undertaken by the nursing hospital are different from those General hospitals. Nursing hospitals are relatively insufficient in medical human resources, equipment, antimicrobial Drugs. At the same time, most of the patients in the nursing hospital have several chronic diseases, long duration of hospital stay, old age, and most have received the antimicrobial treatment in General hospitals. Therefore, mastering microbial species of hospitalized patients in the nursing hospital and the sensitivity and resistance of antimicrobial drugs in clinical can guide the usage of the antimicrobial drug in patients with early-onset.

The objective of this article is to understand the microbial species microbial species, antimicrobial drugs sensitivity and resistance from 2652 cases of patients in the nursing hospital, to bring a clear view of nursing hospital doctors.

2. Information and methods

2.1. Research materials

A retrospective analysis of 2,652 cases of hospitalized patients in five nursing hospitals of Shanghai from January to June 2019. Among them, there were 1202 effective results, 1450 cases of ineffective results, 987 cases have no microbial been found. 379 cases of non-pathogenic bacteria and 84 cases have been polluted. This article analyzes and discusses ineffective results.

2.2. Instruments and reagents

DL-96A bacteria identification and drug sensitivity analyzer produced by Zhuhai Dill Bioengineering Co., Ltd., DL-Bl240 automatic blood culture device.

2.3. Methods

Cultivate and drug sensitivity was carried out by the National Clinical Laboratory Procedures. The drug susceptibility test was carried out by the paper diffusion methods recommended by the American Committee for Clinical Laboratory Standards (CLSI), and the results were judged according to the CLSI-M100 standard.

2.4. Statistical processing

Using SPSS 19.0 statistical software, the count data were expressed as frequency (n), and the chi-square test was used for comparison between groups. P < 0.05 was considered statistically significant.

3. Results

3.1. General information

There were 2652 cases results, of which 1202 were positive.

3.1.1 The gender distribution of a total of 652 female cases, accounted for 54.24%. 550 males cases, accounted for 45.76%.

3.1.2 The age distribution of total ranged from 40 to 110 years old, the youngest was 49 years old, and the oldest was 105 years old. The average age was 82.77 ± 9.09 years old, concentrated in 70–99 years old. Among them, 70–79 years old accounted for 18.55%, 80–89 years old accounted for 48.09%, and 90–99 years old accounted for 21.21% (Table 1).

3.2. Distribution

3.2.1 A total of 57 microbial species were detected in all positive samples, of which 303 cases were Gram-positive microbial species accounted for 25.21%, 808 cases of Gram-negative microbial species accounted for 67.22%, and fungi accounted for 7.57%.

3.2.2 Positive samples were mainly from urine (35.94%) and sputum (48.59%).

3.2.3 The main Gram-positive bacteria in the positive samples were Staphylococcus aureus (53.14%), Enterococcus faecalis (12.87%), Staphylococcus epidermidis (10.23%), Staphylococcus haemolyticus (6.93%), Enterococcus faecium (3.96%).

3.2.4 The main Gram-negative bacteria in the positive samples were E. coli (35.27%), Pseudomonas aeruginosa (20.67%), Klebsiella pneumoniae (13.99%), Proteus mirabilis (8.66%), Bowman Ballacillus (5.57%).

3.2.5 The main fungi in the positive samples were Candida albicans (59.34%), Candida bulgaricus (14.48%), Candida glabrata (14.29%).

3.2.6 Among the main Gram-positive bacteria, Enterococcus faecium and Enterococcus faecalis are easily detected in urine. Staphylococcus haemolyticus and Staphylococcus epidermidis are easily detected in sputum. Staphylococcus aureus is easily detected in sputum and secretions (Table 2).

3.2.7 Among the main Gram-negative bacteria, E. coli and Klebsiella pneumoniae are easily detected in sputum and urine. Proteus mirabilis is easily detected in the urine. Pseudomonas aeruginosa and Acinetobacter baumannii were easily detected in sputum (Table 3).

3.2.8 Among the major fungi, Candida albicans, Candida bulgaricus, and Candida glabrata were easily detected in sputum (Table 4).

3.2.9 There was a statistically significant difference in gender distribution and overall gender distribution between Enterococcus faecalis, E. coli, and Pseudomonas aeruginosa in positive samples (Table 5).

| Age range | Total age distribution. |
|-----------|-------------------------|
| 100–110   | 20                      | 1.66% |
| 90–99     | 255                     | 21.21% |
| 80–89     | 578                     | 48.09% |
| 70–79     | 223                     | 18.55% |
| 60–69     | 110                     | 9.15% |
| 50–59     | 14                      | 1.16% |
| 40–49     | 2                       | 0.17% |
| total     | 1202                    | 100.00% |

Conclusion: There is a difference between this data and the bacteria data in Shanghai. It is necessary to understand the bacteria sensitivity rate and resistance rate of antimicrobial in the nursing hospital, and it has certain guiding significance for the clinical of the nursing hospital.
3.2.10 There was a statistically significant difference in the distribution of specimens between female specimens and the total specimens (Table 6), $\chi^2 = 15.01$, $P < 0.05$.

3.2.11 There were no statistical differences in the distribution of Gram-positive bacteria, negative bacteria and fungi in each month.

3.2.12 There was a statistically significant difference in the distribution of P. aeruginosa in all age groups, $\chi^2 = 25.70$, $P < 0.01$ (Table 7).

3.2.13 The resistance rate of Staphylococcus aureus to levofloxacin and penicillin was >90%, the resistance rate to clindamycin and erythromycin was >80%, the resistance rate to gentamicin was >70%, and vancomycin and linezolid The amine sensitivity rate was 100.0%, the sensitivity rate to rifampicin and teicoplanin was >90%, and the sensitivity to compound sulfamethoxazole and streptomycin was >80% (Table 8). Staphylococcus aureus resistant to vancomycin and linezolid was not found this time.

The resistance rate of E. coli to compound sulfamethoxazole was >60%, the resistance rate to cefuroxime, ceftriaxone, levofloxacin, and

### Table 2. Distribution of specimens of major Gram-positive bacteria.

| Bacterial species | Bacterial name   | type of sample | Constituent ratio |
|-------------------|------------------|----------------|-------------------|
| +                 | Enterococcus faecium | urine          | 75.00%           |
| +                 | Enterococcus faecium | blood-Aerobic  | 16.67%           |
| +                 | Enterococcus faecium | sputum         | 8.33%            |
| +                 | Staphylococcus haemolyticus | sputum   | 47.62%           |
| +                 | Staphylococcus haemolyticus | blood-Anaerobic | 19.05%           |
| +                 | Staphylococcus haemolyticus | blood-Aerobic  | 14.29%           |
| +                 | Staphylococcus haemolyticus | Secretion    | 9.52%            |
| +                 | Staphylococcus haemolyticus | urine        | 9.52%            |
| +                 | Enterococcus faecalis | urine         | 79.49%           |
| +                 | Enterococcus faecalis | sputum        | 15.38%           |
| +                 | Enterococcus faecalis | Secretion    | 5.13%            |
| +                 | Staphylococcus epidermidis | sputum  | 70.97%           |
| +                 | Staphylococcus epidermidis | blood-Aerobic | 12.90%           |
| +                 | Staphylococcus epidermidis | urine       | 6.45%            |
| +                 | Staphylococcus epidermidis | blood-Anaerobic | 6.45%           |
| +                 | Staphylococcus aureus | sputum       | 67.08%           |
| +                 | Staphylococcus aureus | Secretion   | 25.47%           |
| +                 | Staphylococcus aureus | Decubitus Ulcers Secretion | 3.11% |
| +                 | Staphylococcus aureus | urine       | 2.48%            |
| +                 | Staphylococcus aureus | blood-Aerobic | 1.86%           |

### Table 3. Distribution of specimens of major Gram-negative bacteria.

| Bacterial species | Bacterial name   | type of sample | Constituent ratio |
|-------------------|------------------|----------------|-------------------|
| -                 | E.coli           | urine          | 67.37%            |
| -                 | E.coli           | sputum         | 21.75%            |
| -                 | E.coli           | Secretion      | 3.86%             |
| -                 | E.coli           | blood-Aerobic  | 3.51%             |
| -                 | E.coli           | blood-Anaerobic| 2.46%             |
| -                 | E.coli           | Decubitus Ulcers Secretion | 1.05% |
| -                 | Proteus mirabilis | urine         | 94.29%            |
| -                 | Proteus mirabilis | Secretion     | 2.86%             |
| -                 | Proteus mirabilis | sputum        | 1.43%             |
| -                 | Proteus mirabilis | Decubitus Ulcers Secretion | 1.43% |
| -                 | Klebsiella pneumoniae | sputum     | 59.29%            |
| -                 | Klebsiella pneumoniae | urine   | 33.63%            |
| -                 | Klebsiella pneumoniae | Secretion | 4.42%             |
| -                 | Klebsiella pneumoniae | Decubitus Ulcers Secretion | 1.77% |
| -                 | Klebsiella pneumoniae | blood-Aerobic | 0.88%            |
| -                 | Pseudomonas aeruginosa | sputum | 75.45%            |
| -                 | Pseudomonas aeruginosa | urine | 12.57%            |
| -                 | Pseudomonas aeruginosa | Secretion | 9.58%            |
| -                 | Pseudomonas aeruginosa | Decubitus Ulcers Secretion | 2.40% |
| -                 | Acinetobacter baumannii | sputum | 77.78%            |
| -                 | Acinetobacter baumannii | urine   | 13.33%            |
| -                 | Acinetobacter baumannii | Decubitus Ulcers Secretion | 6.67% |
| -                 | Acinetobacter baumannii | blood-Aerobic | 2.22%            |
Ciprofloxacin was >70%, and the resistance rate to cefazolin was >80%. The resistance rate to ampicillin is >90%, the sensitivity rate to nitrofurantoin, minocycline and cefoxitin are >60%, and the sensitivity to cefoperazone sulbactam and piperacillin tazobactam is >70%. The sensitivity of ropamine, imipenem, and amikacin was >80% (Table 9).

3.2.14 The resistance rate of Proteus mirabilis to nitrofurantoin was 100%, the resistance rate to ampicillin was >90%, and the resistance rate to compound sulfamethoxazole, levofloxacin and ciprofloxacin was >80%. For cefazolin and gentamicin The rate of resistance is >70%.

Sensitivity to cefoxitin, imipenem, and amikacin was >80%, and sensitivity to meropenem, cefoperazone sulbactam, and piperacillin tazobactam was >90% (Table 10).

3.2.15 Klebsiella pneumoniae to cefazolin, gentamicin, ampicillin, cefuroxime, ceftazidine, cefotin, ceftriaxone, ampicillin sulbactam, compound sulfamethoxazole, levofloxacin, ciprofloxacin and

Table 4. Distribution of major fungi.

| Bacterial species | Bacterial name        | type of sample | Constituent ratio |
|------------------|-----------------------|----------------|-------------------|
| Fungus           | Candida glabrata      | sputum         | 69.23%            |
| Fungus           | Candida glabrata      | urine          | 15.38%            |
| Fungus           | Candida glabrata      | Secretion      | 7.69%             |
| Fungus           | Candida glabrata      | stool          | 7.69%             |
| Fungus           | Candida albicans      | sputum         | 88.89%            |
| Fungus           | Candida albicans      | urine          | 5.56%             |
| Fungus           | Candida albicans      | stool          | 1.85%             |
| Fungus           | Candida albicans      | blood-Anaerobic| 1.85%             |
| Fungus           | Candida albicans      | Secretion      | 1.85%             |
| Fungus           | Dubliniensis Candida  | sputum         | 73.33%            |
| Fungus           | Dubliniensis Candida  | urine          | 20.00%            |
| Fungus           | Dubliniensis Candida  | Secretion      | 6.67%             |

Table 5. Gender distribution of several bacteria.

| Bacterial species | Bacterial name        | gender | Frequency | Constituent ratio | χ² |
|------------------|-----------------------|--------|-----------|-------------------|----|
| G+               | Enterococcus faecalis | female | 28        | 71.79%            | 4.698* |
| G+               | Enterococcus faecalis | male   | 11        | 28.21%            |    |
| G-               | E.coli                | female | 187       | 65.61%            | 12.11** |
| G-               | E.coli                | male   | 98        | 34.39%            |    |
| G-               | Pseudomonas aeruginosa| male   | 104       | 62.28%            | 16.03** |
| G-               | Pseudomonas aeruginosa| female | 63        | 37.72%            |    |

*aP < 0.05  **P < 0.01.

Table 6. Distribution of patient gender and specimen types.

| gender type of sample | Frequency | Constituent ratio | gender type of sample | Frequency | Constituent ratio | gender type of sample | Frequency | Constituent ratio |
|-----------------------|-----------|-------------------|-----------------------|-----------|-------------------|-----------------------|-----------|-------------------|
| female urine          | 276       | 42.33%            | male urine            | 156       | 28.36%            | urine                 | 432       | 35.94%            |
| female sputum         | 261       | 40.03%            | male sputum           | 323       | 58.73%            | sputum                | 584       | 48.59%            |
| female Secretion      | 70        | 10.74%            | male Secretion        | 30        | 5.45%             | Secretion             | 100       | 8.32%             |
| female blood-Aerobic  | 20        | 3.07%             | male blood-Aerobic    | 18        | 3.27%             | blood-Aerobic         | 38        | 3.16%             |
| female blood-Anaerobic| 16        | 2.45%             | male blood-Anaerobic  | 9         | 1.64%             | blood-Anaerobic       | 25        | 2.08%             |
| female Decubitus Ulcers Secretion | 8 | 1.23% | male Decubitus Ulcers Secretion | 13 | 2.36% | Decubitus Ulcers Secretion | 21 | 1.75% |
| female stool          | 1         | 0.15%             | male stool            | 1         | 0.18%             | stool                 | 2         | 0.17%             |
| total                 | 652       | 100.00%           | total                 | 550       | 100.00%           | total                 | 1202      | 100.00%           |

Table 7. Age distribution of Pseudomonas aeruginosa.

| Bacterial name        | Age range | Frequency | Constituent ratio |
|-----------------------|-----------|-----------|-------------------|
| Pseudomonas aeruginosa| 50–59     | 1         | 0.60%             |
| Pseudomonas aeruginosa| 60–69     | 26        | 15.57%            |
| Pseudomonas aeruginosa| 70–79     | 48        | 28.74%            |
| Pseudomonas aeruginosa| 80–89     | 74        | 44.31%            |
| Pseudomonas aeruginosa| 90–99     | 18        | 10.78%            |
| total                 | 167       |           | 100.00%           |
The resistance rate was >60%, the sensitivity rate to amikacin was only >60%, and the sensitivity to imipenem and meropenem was only >50% (Table 11).

3.2.16 Pseudomonas aeruginosa tested resistance to antimicrobial <50%, sensitivity to ceftazidime, cefepime, meropenem, imipenem, amikacin >60%, sensitivity to polymyxin B >90%, sensitivity to tigecycline was 100% (Table 12).

3.2.17 The resistance rate of Candida glabrata to fluconazole was >60%, the sensitivity rate to amphotericin B, fluconazole and itraconazole was >60%, and the sensitivity to voriconazole was >90% (Table 13).

4. Discussion

4.1. Reasons for the high proportion of middle-aged and elderly inpatients in nursing hospital

1. Affected by the rapid economic development, increased cost of living, and gradual increase in medical standards, China has gradually entered a stage of low fertility rate, high life expectancy, and high aging [1, 2]. As an economically developed city in China, Shanghai is more aging than other cities in China. The proportion of elderly people over 60 years old is as high as 30.2% [2]. At the same time, the one-child policy is also an influential cause the elderly became a heavy burden for their children [3, 4].

2. The government has set up category such as nursing hospital to fit the need of the perspectives of the medical needs of elderly patients and the service contents of general hospitals since 2010.

4.2. Reasons for differences between microbial species detected in nursing hospitals and results in Shanghai

According to Yang Yang’s ‘2017 Shanghai bacterial resistance monitoring’ study, the total number of Gram-positive bacteria in 49 general hospitals in Shanghai was named Enterococcus, Staphylococcus aureus, and β-hemolytic streptococcus. Gram-negative staphylococci, Streptococcus pneumonia, and Streptococcus mutants. The types and rankings of Gram-positive bacteria detected in this study are partially different from results of Shanghai, and the types of Gram-negative bacteria in this study consistent with results of Shanghai, the rankings are partially different [5]. The patients in the nursing hospital in this study was mostly those over 60 years old, and the patients in general hospitals were evenly distributed in different age groups is the possible causes of differences in the ranking of bacteria. Therefore, the selection of antimicrobial in...
Table 10. Antimicrobial sensitivity rate and resistance rate of Proteus mirabilis (%).

| Bacterial name type           | Proteus mirabilis | Proteus mirabilis | Proteus mirabilis |
|-------------------------------|-------------------|-------------------|-------------------|
|                               | I                 | R                 | S                 |
| Nitrofurantoin                | 0 (0)             | 64 (100)          | 0 (0)             |
| Cefazolin                    | 3 (4.29)          | 53 (75.71)        | 14 (20)           |
| Gentamicin                   | 3 (4.29)          | 53 (75.71)        | 14 (20)           |
| Ampicillin                   | 0 (0)             | 63 (90)           | 7 (10)            |
| Cefuroxime                   | 1 (1.45)          | 47 (68.12)        | 21 (30.43)        |
| Ceftriaxime                  | 6 (23.08)         | 6 (23.08)         | 14 (53.85)        |
| Cefepime                     | 16 (22.86)        | 23 (32.86)        | 31 (44.29)        |
| Cefoxitin                    | 3 (4.29)          | 10 (14.29)        | 57 (81.43)        |
| Cefoperazone sulbactam       | 1 (1.45)          | 40 (57.97)        | 28 (40.58)        |
| Piperacillin tazobactam      | 0 (0)             | 2 (2.86)          | 68 (97.14)        |
| Ampicillin sulbactam         | 9 (12.86)         | 30 (42.86)        | 31 (44.29)        |
| Meropenem                    | 0 (0)             | 3 (4.35)          | 66 (95.65)        |
| Imipenem                     | 8 (11.43)         | 3 (4.29)          | 59 (84.29)        |
| Amikacin                     | 3 (4.29)          | 11 (15.71)        | 56 (80)           |
| Compound sulfamethoxazole    | 0 (0)             | 61 (88.41)        | 8 (11.59)         |
| Levofloxacin                 | 1 (1.43)          | 58 (82.86)        | 11 (15.71)        |
| Ciprofloxacitin              | 2 (2.86)          | 58 (82.86)        | 10 (14.29)        |
| Minocycline                  | 1 (1.43)          | 69 (98.57)        | 0 (0)             |

Table 11. Antimicrobial sensitivity rate and resistance rate of Klebsiella pneumoniae (%).

| Bacterial name type           | Klebsiella pneumonia | Klebsiella pneumonia | Klebsiella pneumonia |
|-------------------------------|----------------------|----------------------|----------------------|
|                               | I                    | R                    | S                    |
| Nitrofurantoin                | 5 (13.51)            | 21 (56.76)           | 11 (29.73)           |
| Cefazolin                    | 2 (17.9)             | 97 (86.61)           | 13 (11.61)           |
| Gentamicin                   | 0 (0)                | 74 (65.49)           | 39 (34.51)           |
| Ampicillin                   | 0 (0)                | 106 (99.07)          | 1 (0.93)             |
| Cefuroxime                   | 0 (0)                | 91 (81.98)           | 20 (18.02)           |
| Cefazidime                   | 1 (3.23)             | 21 (67.74)           | 9 (29.03)            |
| Cefepime                     | 12 (16.91)           | 64 (58.18)           | 34 (30.91)           |
| Cefoxitin                    | 3 (2.78)             | 71 (65.74)           | 34 (31.48)           |
| Ceftriaxime                  | 1 (0.91)             | 83 (75.45)           | 26 (23.64)           |
| Cefoperazone sulbactam       | 8 (7.14)             | 48 (42.86)           | 56 (50)              |
| Piperacillin tazobactam      | 9 (8.11)             | 50 (45.05)           | 52 (46.85)           |
| Ampicillin sulbactam         | 7 (6.31)             | 78 (70.27)           | 26 (23.42)           |
| Meropenem                    | 1 (0.89)             | 46 (41.07)           | 65 (58.04)           |
| Imipenem                     | 5 (4.46)             | 47 (41.96)           | 60 (53.57)           |
| Amikacin                     | 0 (0)                | 38 (33.93)           | 74 (66.07)           |
| Compound sulfamethoxazole    | 0 (0)                | 71 (63.96)           | 40 (36.04)           |
| Levofloxacin                 | 5 (4.46)             | 78 (69.64)           | 29 (25.89)           |
| Ciprofloxacitin              | 5 (4.59)             | 80 (73.39)           | 24 (22.02)           |
| Minocycline                  | 31 (28.7)            | 26 (24.07)           | 51 (47.22)           |

nursing hospital needs to be considered the actual situation of the local nursing hospital. Because of the limited number of patients in this study, the study of bacterial in nursing hospitals in a large number of patients will be performing in the future.

4.3. The significance of gender and microbial species in nursing hospital for clinical intervention

In this study, the proportion of E. coli and Enterococcus faecalis in female patients was twice as high as that in male patients, and the gender distribution of the total study cases was statistically different. It was the most easily detected in urine and the bacteria in the urine of female patients [6, 7], be consistent with the conclusions of Sun Shuhong et al. 2014 "Analysis of distribution and drug resistance of enterococci in patients with urinary tract infection" [8]. The possible reason is the physiological structure of female patients, long-term hospitalized period, female patients have higher urinary tract infections rate [4, 5, 6, 7, 8]. Clinically, if there are the elderly female who has been bedridden for a long time, accompanied by fever, and diagnosed as urinary tract infections, the antimicrobial which against E. coli and Enterococcus faecalis can be used without the test results in the early stage. Inconsistent with the conclusions of Cao Cuiming and Zhang Xiuping's "Analysis of Clinical Relevant Factors and Drug Resistance of Urinary System Infection Enterococci" [9], the possible reasons is 1. The difference in the different functions of central hospitals and nursing hospital may cause...
the different age distribution. 2. The sample size of this study is insufficient, and further research will be carried out in the future.

In this study, the proportion of male patients infected with Pseudomonas aeruginosa was nearly twice that of female patients, and the gender distribution of the cases was statistically different. The frequency of Pseudomonas aeruginosa found in sputum was 5 times that of other specimens. And male patients have the highest bacterial positive rate in sputum [10], be consistent with the conclusion of Song Haoyue and Huang Kaifeng, "Clinical Distribution of Pseudomonas aeruginosa Different Drug-resistant Strains in a Shanghai Hospital from 2014 to 2017" [11]. The possible reasons are cigarette smoking [12], increased incidence of COPD is higher than female [14, 15], hypertension [16], the incidence rate in sputum [10], be consistent with the conclusion of Song Haoyue and Huang Kaifeng, "Clinical Distribution of Pseudomonas aeruginosa Different Drug-resistant Strains in a Shanghai Hospital from 2014 to 2017" [11]. The possible reasons are cigarette smoking [12], decreased resistance capability in elderly patients [13], and the incidence of COPD is higher than female [14, 15], hypertension [16], the incidence of cerebrovascular accidents is higher than that of female [17], combined with elderly patients with long-term hospitalized period, disturbance of consciousness, using nasogastric tube and other reasons [18]. Clinically, if a male patient is bedridden for a long time, with disturbance of consciousness, accompanied by fever, diagnosed as aspiration pneumonia, pulmonary infection, the antimicrobial which against Pseudomonas aeruginosa can be used without the test results in the early stage.

Besides, the positive rate of bacteria in the urine of female patients is the highest, the rate is 42.33%. urine culture is the primary choice for Female patients, the pros are the procedure of sampling is convenient, no pain and high positive rate [19]. The positive rate of bacteria in sputum was the highest in male patients, and the detection rate was 58.73%. Sputum culture is the primary choice for male patients, which sampling procedure is very easy, no pain and high positive rate [10].

4.4 Pseudomonas aeruginosa has high drug resistance rate, low sensitivity rate, high mortality rate, and hard for curing [20]. It widely exists in natural environment and has strong virulence. It is an important cause for infection, hemorrhoids, abscess and suppurative otitis media [21]. First, in this study, there was a statistically significant difference in the distribution of P. aeruginosa infections among different age groups [22], with 70–89 years old accounting for the highest proportion, account for 73.05%, and 90–99 years old accounting for the least, accounting for 10.78%. according to the Shanghai 2018 Statistical Yearbook, life expectancy at birth is 83.37 years. The possible reasons are bacterial virulence and lung infections in elderly patients [15], and the physical functions are decreasing of elderly patients. Be consistent with the conclusion of Xing Hongwen’s 2017 "Structure of Pathogenic Bacteria and Risk Factors of Death in Elderly Patients with Severe Pneumonia"[23],elderly patients who have been infected with Pseudomonas aeruginosa have a high mortality rate and need to be treated ASAP. The sensitivity of P. aeruginosa to several major antimicrobial such as cefazidime, cefepime, meropenem, imipenem, and amikacin are not sensitive to Pseudomonas aeruginosa resistance capability will finally appear [25]. In this study, Pseudomonas aeruginosa was much more sensitive to polymyxin B and tigecycline than the others [26, 27]. At present, only the polymyxin B ointment and tigecycline for injection are available in the Shanghai Medical Insurance Drug List. Due to the limited economic conditions, it is recommended to add the other dosage forms of polymyxin B and lower price of tigecycline.

4.5 Fungal has more chance to detected in sputum. Candida glabrata, Candida albicans, Dubliniensis are common pathogens in fungi, and Candida albicans is more virulence. In this study, all three fungi were detected in sputum, and the possible cause was pulmonary infection caused by fungal pneumonia. The sensitivity of these fungi to fluconazole and itraconazole was acceptable. Amphotericin B and voriconazole are more sensitive [20, 28]. In clinical, sputum is easily contaminated by oropharyngeal colonization bacteria. if the result was fungi in sputum, the test should be reviewed. The sampling personnel should take the training program before taking samples.
The increased resistance rate of Staphylococcus aureus is one of the most important parts of clinical bacteria control. Staphylococcus aureus is an important pathogen in Gram-positive bacteria, it has high Pathogenicity [29], which is common in skin, nasal cavity, throat, gastrointestinal, sputum, and purulent wounds [30, 31], be consistent with the conclusion of Li Ling, Lin Zhonghua and others in 2019 "Analysis of the distribution and drug resistance of nosocomial and community infections of Staphylococcus aureus from 2015 to 2018" [32]. In this study, S. aureus was more common in sputum and secretion. It has produced very strong resistance capability to a variety of antibiotics, which levofloxacin and penicillin are essentially ineffective. The possible cause of the analysis was due to the abuse of β-lactam antimicrobial in the early stage when the drug comes out. At the same time, studies have shown that Staphylococcus aureus has an increasing trend in resistance to compound sulfamethoxazole and rifampicin [33, 34], the nursing hospital needs to deal with the problems such as long hospital stays, and more patients in the ward and very complex patient's condition. In the future, it is necessary to strengthen the antibiotics training program for doctors and the administrator of the hospital should pay attention to it.

4.7 Intestinal pathogens are common to clinical and food bacterial prevention. E. coli and Proteus mirabilis are conditional pathogens that are widely present in the intestine. The enterotoxin produced by them is an important cause of diarrhea, abdominal pain and fever in elderly patients [35, 36], which can lead to death. In this study, the two strains have detected a strong resistance capability to all are widely present in the intestine. e cause of the analysis is caused by the abuse of β-lactams and cephalosporins. E. coli and Proteus mirabilis are easy to grow in food. In the future, the nursing hospital must strengthen the in-hospital inspection of food hygiene, and strengthen the bacterial prevention capability of cooking, delivering, and distributing [37, 38].

4.8 Klebsiella pneumoniae has a high rate of drug resistance capability, low sensitivity to many antibiotics and it can be transmitted through the respiratory tract, which considers the most difficult part in clinical [39]. Klebsiella pneumoniae is the most important pathogen in the genus Klebsiella. The bacterium has a capsule with strong resistance, rapid growth and reproduction, and lower resistance capability of elderly patients [40]. Conclusions consistent with the 2017 "Clinical Distribution 2013–2015 1830 Klebsiella pneumoniae infection and drug resistance," Zhanling Ling, Huang Haixia, etc [41]. The possible reasons are the bacteria can be transmitted through the respiratory tract, and the nursing hospital patients have a long hospital stay and a high exposure risk. Once the infection is happening, the process running rapid and the mortality rate is very high. In this study, Klebsiella pneumoniae has shown the resistance to all tested antimicrobial which is cephaline, cefoperazone sulbactam, piperacillin tazobactam, meropenem, imipenem. there are not any choice available for doctors in the nursing hospital. It is the most important part that the administration should pay attention to [15].

4.9 Interventions

Since the daily care of nursing hospitals are mainly carried out by the care workers, which are an important part of personnel in the nursing hospitals. The people do not have the medical background, sometimes they are exaggerating the harm of bacteria. It is very easy to create a panic in the nursing hospital. Therefore, at present, the following interventions are carried out in a nursing hospital on a small scale.

4.9.1 Intervention

4.9.1.1 Adjust the hospital antimicrobial drug list, add drugs into the list: telcoomplan for injection, enteric-coated tablets for nitrofurantoin, piperacilllin sodium tazobactam for injection, tigecycline for injection, amphotericin B liposomes for injection, itraconazole dispersible tablets, the antibacterials which are essentially ineffective remove from the list: clindamycin phoshphate for injection, cefuroxime sodium for injection.

4.9.1.2 the result of the bacteriological investigation is conducted and published monthly.

4.9.1.3 Isolating the patient and perform the air sterilizer protocol daily in the specific ward.

4.9.1.4 Strengthen the protection for the medical personnel and increase the implementation of hand hygiene procedure.

4.9.1.5 Strengthen training on infection prevention and control knowl-edge. The training of this knowledge for care workers is easily ignored. While strengthening the training for the care workers is a very effective way to prevent cross-infection in the ward.

4.9.1.6 Increase air ventilation.

4.9.1.7 Inform the specific patient's information to the medical personnel ASAP.

4.9.2. Intervention results

After 3 months of intervention, some goals were achieved. Firstly, the illness can be treated in the early stage. Secondly, the cost can be reduced. Finally, increase the prevention awareness among medical personnel in a nursing hospital.

5. Outlook

At present, compared with general hospitals, the nursing hospital is faced with complicated patients and very few antimicrobial drugs, lack of policy, lack of funds, lack of medical personnel, and the patients family members lack the willingness to pay the bill for the treatment. It is expected that the departments will give greater policy and funding support to the nursing hospital's prevention work in the future. At the same time, the nursing hospital should also increase prevention capability, improve the training program. Also expected that the society can strengthen prevention propaganda and moral education, improve the willingness of patients’ families, and give more understanding and support for the nursing hospitals.

Declarations

Author contribution statement

Y. Wu: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.
J. Xu: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Additional information

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