Periodic Surveillance of Systemic Infection Antibiogram a Necessity – A Retrospective and Prospective Study

Shanmuga Vadivoo Natarajan¹*, G. Kalaiselvi¹, B. Usha² and B.K. Padmavathi³

Department of Microbiology, Annapoorana medical college & Hospital, Salem-636308, India

*Corresponding author

ABSTRACT

Periodic monitoring and surveillance of hospital antibiogram is mandatory because making an Antibiogram is the first step before framing Hospital Antibiotic policy. In this study, during the reference period (Retrospective - January 2013-December 2014 & Prospective period-January 2015-December 2015) a periodic surveillance of Anatomic site wise stratified antibiogram for blood, wound/soft tissue, respiratory and urine samples was done as per CLSI guidelines. Prevalent rates of Multi Drug resistant (MDR) pathogens-ESBL Enterobacteriaceae, MRSA, MDR Gram negative Non fermenters were reported. Prevalent Blood stream Pathogens were Klebsiella (17.2%) & CONS (27.2%), Wound pathogens Pseudomonas (25.3%) & Staphylococcus aureus (26.4%), Respiratory tract Pathogens Klebsiella (36.1%) & Pseudomonas (22.4%) and Urinary tract Pathogens E.coli (45%), & Klebsiella (17%). Klebsiella had improved susceptibility for Respiratory & Blood stream infection when compared to UTI. Pseudomonas showed improved susceptibility profile for both wound and respiratory infection. Drug resistance increased for E.coli during the reference period. Staphylococcus was reported with increasing susceptibility profile when compared with Enterococci. Though there was increasing trend in sensitivity percentage for most of the antibiotics during the prospective period when compared to retrospective period a narrow spectrum of sensitivity was observed for commonly used antibiotics.

Keywords
Periodic Surveillance, Antibiogram.

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Introduction

In the era of increasing Antimicrobial resistance due to Antimicrobial misuse and reduced emphasis on antibiotic development by pharmaceutical manufacturers. There has been a major international effort to tackle global challenge of Antimicrobial resistance and our national center for disease control has published National treatment guidelines and Antimicrobial policy for antibiotic use in Infectious disease (http://www.ncdc.gov.in/writereaddata/linkimages/AMR_guideline7001495889.pdf). Antibiotic policy is one of the mandatory requirements for accreditation and making an Antibiogram is the first step before framing Antibiotic policy (http://www.ncdc.gov.in/writereaddata/linkimages/AMR_guideline7001495889.pdf);
Hospital antibiogram, 2010; Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America, 2007). Planning an empiric Antibiotic policy in a hospital utilizes subgroup specific Antibiogram analysis. Standard guidelines for constructing antibiogram are given by organizations like CLSI, IDSA, CDC and WHO (Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America, 2007; Analysis and presentation of cumulative antibiograms, 2007; Specification for a Hospital Cumulative Antibiogram, 2013). They also endorse and recommend the use of appropriate empiric antibiotic therapy based on local microbiological results and their Local Antibiogram. Also most convenient and widely used available measure of a hospital’s proportion of resistant organism is hospital cumulative Antibiogram. The need for reliable accurate Antibiogram data is critical to guide appropriate antibiotic selection.

The cumulative hospital Antibiogram is a periodic summary of Antibiotic susceptibility of local bacterial isolates. The objectives of cumulative Antibiogram is to present useful validated information in a consistent way to Clinicians and Policy makers to assess’ local susceptibility rates .It also helps in clinician’s decision towards selecting appropriate empiric antibiotic therapy and also change in prescribing & infection control practices. It guides in monitoring antimicrobial resistance trends over time with in an Institute (ICU / ward specific, IP vs. Op) and this can make substantial contribution to patient outcome without additional testing (Atul et al., 2010; Shanmuga et al.). Aggregates of antibiograms from specific regions would help in monitoring trends across a community & nation (Diane et al., 2004). Local Antibiogram data is useful for optimized empirical antibiotics therapy.

Antibiograms of pathogens vary markedly between hospitals and between different systemic infection types.

**Background**

Susceptibility statistics consisting of cumulative and ongoing summary of patterns of antibiotics sensitivity of clinically important bacteria are important for various health care practitioners & Microbiologists. The most common use of hospital antibiogram data is probably for assisting clinicians with empiric therapy for suspected infections.

Our tertiary care hospital has been reporting MDR (Multi drug resistant) pathogens from almost all of clinical samples types from different clinical units. As we are in the process of framing an official Antibiotic policy, retrospective surveillance of our hospital Antibiogram will help in framing our Institute’s effective Antibiotic policy and prospective surveillance will strengthen the same. This surveillance study will also help in identifying the prevalent MDR pathogens from specific clinical specimen type at our tertiary care center which will ultimately lead to implementation of Specific Infection control practices in those areas accordingly. Moreover, because there will be hardly any new antibiotics in near future, a better understanding of institutional antibiogram is needed on how to optimize the use of existing antibiotics, either alone or in specific combinations.

The aim and objectives of this study includes;

Retrospective Surveillance (Jan 2013-Dec 2014)of Cumulative Antibiogram to identify the most prevalent pathogens isolated from specific anatomic sites & trends in Antibiotic sensitivity pattern of the same. Prospective Surveillance (Jan 2015-Dec...
279 of Antibiogram for tracking the shift in trends of MDR pathogens and guidance for a necessity to change in prescribing and infection control practices.

**Materials and Methods**

This study was conducted at a 650 bedded tertiary care hospital. All the pathogens isolated from specific clinical samples (Blood, wound/pus, Respiratory tract specimens (throat swabs, sputum, Endotracheal secretions, etc.) and urine) submitted for culture/sensitivity to central Microbiology Lab during the Retrospective period (January 2013-December 2014) and Prospective period (January 2015-December 2015) was analyzed. In this study the bacterial profile of Blood stream infections, wound infections, Respiratory tract infections and Urinary tract infections reported. Also the trending antibiogram of the most frequently isolated pathogen of the above mentioned infection syndrome during the mentioned study period was recorded and analyzed. The identification of bacterial isolates and antibiotic susceptibility interpretation for drugs tested against most frequently isolated pathogens is reported according to CLSI guidelines. The cumulative antibiogram was constructed for pathogens isolated from the above mentioned infection syndrome in accordance with the CLSI guidelines. The antibiogram was manually constructed and we included first isolate per patient and excluded duplicate isolates. Trending of Drug resistance /multi drug resistance was recorded for the prevalent pathogen for the mentioned infection syndrome.

The antibiotic discs that were used to identify the susceptibility pattern of the bacterial pathogens and their concentrations included penicillin (10 mcg), amikacin (30 mcg), ceftazidime (70 mcg), ceftriaxone (30 mcg), cefoxitin (10 mcg), ciprofloxacin (5 mcg), clindamycin (2 mcg), erythromycin (10 mcg), gentamicin (10 mcg), imipenem (10 mcg), linezolid (30 mcg), piperacillin/tazobactum(Pip-Taz) combination (100/10 mcg), and vancomycin (30 mcg).

**Results and Discussion**

Antibiotic susceptibility of pathogen can vary markedly between different hospital location and between different clinical specimens. In this study we aim in highlighting the bacterial profile of Blood stream, wound/soft tissue, respiratory tract and Urinary tract infections and cumulative antibiogram of three most prevalent pathogens isolated from each of the above mentioned infection syndrome. Also we have compared the trending susceptibility pattern of the most prevalent isolated pathogen from clinical specimens.

In Table-1 we have enumerated the bacterial profile of Blood stream Pathogens. The most prevalent gram negative being *Klebsiella & Other Nonfermenting Gram Negative Bacilli (NFGNB)* and gram positive *CONS*.

Table-2 highlights the Cumulative sensitivity of most prevalent blood stream pathogens for three year study period (Jan 2013 to Dec 2015)

Trending sensitivity pattern of the prevalent blood stream infection pathogen individually for the each study period is shown in Table-3. Last row highlights the Trending drug resistance percentage (ESBL-Extended spectrum beta lactamases) In Table-4 we have enumerated the bacterial profile of Soft tissue/Wound infection. The most prevalent gram negative being *Pseudomonas* followed by *E.coli* and gram positive *Staphylococcus aureus*. 
Table-5 highlights the Cumulative sensitivity of most prevalent wound pathogens for three year study period (Jan 2013 to Dec 2015).

Trending sensitivity pattern of the prevalent wound infection pathogen individually for the each study period is shown in Table-6. Last three rows highlights the Drug resistance percentage (ESBL-Extended spectrum beta lactamases, MRSA-Methicillin resistant staphylococcus aureus and MDR % of Pseudomonas)

In Table-7 we have enumerated the bacterial profile of Respiratory tract Pathogens. The most prevalent gram negative being Klebsiella followed by Pseudomonas and gram positive Staphylococcus aureus.

Table-8 highlights the Cumulative sensitivity of most prevalent Respiratory tract pathogens for three year study period (Jan 2013 to Dec 2015). Trending sensitivity pattern of the prevalent Respiratory pathogen individually for the each study period is shown in Table-9. Last three rows highlights the Drug resistance percentage (ESBL-Extended spectrum beta lactamases, CR-carbapenem resistance, MRSA-Methicillin resistant staphylococcus aureus and MDR % of Pseudomonas)

In Table-10 we have enumerated the bacterial profile of Urinary tract infection. The most prevalent gram negative being E.coli followed by Klebsiella and gram positive Enterococci

Table-11 highlights the Cumulative sensitivity of most prevalent Urinary tract pathogens for three year study period (Jan 2013 to Dec 2015)

Trending sensitivity pattern of the prevalent Uropathogen individually for the each study period is shown in Table-12. Last three rows highlights the Drug resistance percentage (ESBL-Extended spectrum beta lactamases, CR-carbapenem resistance, VRE-Vancomycin resistant Enterococci)

Cumulative hospital Antibiogram, which is an integral part of Antimicrobial stewardship (AMS) was previously, reported hospital wide. Later CLSI has published consensus guide lines recommending stratification of susceptibility data by patient population wise or Anatomic site wise, or location wise. In this study, during the reference period (Retrospective -January 2013-December 2014 & Prospective period-January 2015-December 2015) we have done a periodic surveillance of Anatomic site wise stratified antibiogram with specific reference to blood, wound/soft tissue, respiratory and urine.

**Blood stream Infection (Table 1, 2 & Table: 3):** For the entire study period the most prevalent gram negatives isolated from blood were Klebsiella (17.2%) followed by Other NFGNB (13%) and CONS (27.2%) among gram positives as shown in Table: 1. Imipenem and Colistin sensitivity remained 100% throughout the study period (Table-2 and Table-3)) for both Klebsiella & Other Nonfermenting Gram negative bacilli. ESBL Klebsiella percentage declined from 100% in 2013 to 45% in 2015 as shown in Table: 3. Vancomycin & Linezolid showed a slight decline in sensitivity for CONS in 2014 but increased to 100% in 2015 (Table-3). The trending sensitivity for Klebsiella was increasing for most of the antibiotics except Pipericilin-Tazobactum. But for other NFGNB’s though Imipenem, Pip-Taz & Colistin remained 100% susceptible, there was a declining trend seen for other antibiotics. The susceptibility trend for CONS improved for most of the antibiotics as shown in Table-3

In a study by Shilpi et al., (2016) E.coli was the predominant blood stream pathogen
Soft tissue/wound infections (Table 4, 5 & Table: 6): Prevalent gram negative was Pseudomonas (25.3%) with improving sensitive percentage for ceftazidime from 58% in 2013 to 70% in 2015. Imipenem sensitivity remained 100% throughout the study period, but colistin & Pip-taz % declined in 2015. MDR % decreased from 41.6% in 2013 to 13.1% in 2015. E.coli second common GNB isolated (14.2%) showed decline in susceptibility profile in 2015 for most of the antibiotics. Carbapenam resistance increased from 0% in 2013 to 11 % in 2015 and ESBL percentage also increased from 89% to 96%. Staphylococcus aureus was prevalent gram positive (26.4%) for which Vancomycin & Linezolid sensitivity improved from 97% in 2013 to 100% in 2015 and MRSA rates halved from 40 % in 2013 to 20 % in 2015. Increasing drug resistance was seen in E.coli.

Similar results are reported by Sah et al., (2013) and dipender et a l. (2012) where in Staphylococcus (41% & 33.8%), Pseudomonas (11.5% & 20.4%) & E.coli (11.5% & 17.4%) are predominant wound pathogens respectively. Similar susceptibility profile was reported for Staphylococcus by Sah et al., but improved sensitivity percentage was seen in study by Dipender etal.

Respiratory tract infection (Table 7, 8 & Table: 9): Prevalent respiratory gram negative pathogen was Klebsiella (36.1%) followed by Pseudomonas (22.4%). Imipenem & Piperclillin-Tazobactum remained 100% sensitive for Klebsiella. For Pseudomonas Imipenam sensitivity improved from 97 % in 2013 to 100% in 2015. Susceptibility profile improved for most antibiotics during the prospective period when compared to retrospective period. MDR percentage for Pseudomonas declined from 10.8% to 7.1% and ESBL Klebsiella reduced from 89% in 2013 to 36% in 2015. Prevalent Gram positive were Streptococcus (17%) followed by Staphylococcus aureus (7.0%). For Staphylococcus Vancomycin & Linezolid remained 100% sensitive and MRSA percentage reduced from 21% in 2013 to 11% in 2015.

Similar reports from studies by Syed et al., (2013), Sarmah et al., (2016), Vijay et al., (2016) & Ashok kumar et al., show Klebsiella, Pseudomonas & Staphylococcus as Predominant respiratory pathogens. Anvari et al., reported Pseudomonas, Acinetobacter as prevalent respiratory pathogens. Syed et al., Anvari et al., & Vijay et al., reported decreased susceptibility profile for most antibiotics and Sarmah et al., reported a good susceptibility when compared to our study.

Urinary tract infections: The prevalent Gram negative was E.coli (45%) followed by Klebsiella (17%). Imipenem sensitivity reduced for E.coli during the study period (Imipenem 100% in 2013 & 94% in 2015) when compared to Klebsiella (89% in 2013 & 100% in 2015). The sensitivity percentage of other antibiotics like ceftazidime, Norfloxacin & Nitrofurantoin for E.coli & Klebsiella remained same at low percentage. ESBL percentage for both E.coli & Klebsiella almost remained same throughout
the study period. Enterococci was prevalent but declining susceptibility profile for gram positive at 13.4% showed improved sensitivity for Gentamicin & Nirofurantoin Table.1 Bacterial profile of Blood stream Infection

| Organisms         | 2013 | 2014 | 2015 | TOTAL |
|-------------------|------|------|------|-------|
| Total Number of Samples received | 498  | 631  | 1208 | 2337  |
| Klebsiella        | 34   | 17%  | 38   | 17%   | 40   | 17.2% | 112  | 17.2% |
| Salmonella        | 21   | 10%  | 25   | 11.7% | 33   | 14.1% | 79   | 12%   |
| E.coli            | 20   | 9.5% | 2    | 0.9%  | 10   | 4.2%  | 32   | 5%    |
| Other NFGNB       | 17   | 8%   | 38   | 17.8% | 30   | 13%   | 85   | 13%   |
| Acinetobacter     | 22   | 11%  | 8    | 3.6%  | 7    | 3%    | 37   | 6%    |
| Pseudomonas       | 22   | 11%  | 16   | 7.5%  | 21   | 9%    | 59   | 9%    |
| MSSA              | 36   | 17.5%| 18   | 8.4%  | 12   | 5.2%  | 66   | 10%   |
| CONS              | 33   | 16%  | 68   | 31.8% | 76   | 33%   | 177  | 27.2% |
| Enterococci       | -    | -    | 1    | 0.5%  | 3    | 1.3%  | 4    | 0.6%  |
| TOTAL             | 205  | 214  | 232  | 261   |

Table.2 Antibiogram for three year period (Jan 2013 – Dec 2015) of three prevalent Blood Stream Infections (BSI) pathogen Microbiology Data – (n- 651)

| Most Common Pathogens | Number of Isolate | Prevalence % | Antibiotic Sensitivity % |
|-----------------------|-------------------|--------------|--------------------------|
| Klebsiella            | 112               | 112/651=17.2%| Amik-35%, Genta-13.4%, Cefotax-26%, Ceftaz-21.4%, Cipro-0.9%, Doxy-42%, Pip taz-89.3%, Imipenem & Colistin-100%. ESBL: 78.6% |
| Other Non-Fermenting Gram negative bacilli | 85              | 85/651=13%   | Amik-65%,Genta-59%,Cefotax-49%,Ceftaz-51.%,Cipro-58%, Pip -taz, Imipenem & Colistin-100% |
| Coagulase Negative Staphylococcus | 177             | 177/651=27.25%| Genta-91%, Cefazolin-61%, Cefotaxime-96%,Cipro-86.4%,Erythro-79%,Clinda-86%,Linezolid-99.4%,Vanco-99.4% |
Table 3: Trending Sensitivity pattern of three prevalent Blood stream Pathogen for three year study period

|                | Klebsiella-17.2% (112-Isolates) | NFGNB-13% (85-Isolates) | CONS-27.2% (177-Isolates) |
|----------------|---------------------------------|--------------------------|---------------------------|
|                | 2013 | 2014 | 2015 | 2013 | 2014 | 2015 | 2013 | 2014 | 2015 |
| No of isolates | 34   | 38   | 40   | 17   | 38   | 30   | 33   | 68   | 76   |
| Amikacin       | 11.8%| 39.5%| 50%  | 100% | 39.5%| 73.3%| 100% | 76.4%| 100% |
| Genta          | 5.8% | 21%  | 12.5%| 94.1%| 39.5%| 63.3%| 100% | 60.5%| 100% |
| Cefazolin      | 0    | 0    | 2.5% | 94.1%| 60.5%| 10%  | 100% | 88.2%| 100% |
| Cefotaxime     | 5.8% | 7.9% | 60%  | 94.1%| 60.5%| 10%  | 100% | 88.2%| 85.5%|
| Ceftazidime    | 0    | 5.3% | 55%  | 94.1%| 63.5%| 10%  | 100% | 100% | 100% |
| Ciprofloxacine | 0    | 0    | 2.5% | 88.2%| 60.5%| 36.6%| 84.8%| 88.2%| 85.5%|
| Ofloxacin      | 0    | 39.5%| 27.5%| 94.1%| 63.5%| 53.3%| 81.8%| 88.2%| 86.8%|
| Doxy           | 11.8%| 60.5%| 40%  | 100% | 100% | 100% | 100% | 100% | 100% |
| Imipenem       | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Pi-Taz         | 88%  | 92.1%| 87.5%| 100% | 100% | 100% | 100% | 100% | 100% |
| Colistin       | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Erythro        |      |      |      | 51.5%| 78%  | 92.1%|      |      |      |
| Clinda         |      |      |      | 48.4%| 97%  | 92.1%|      |      |      |
| Linezolid      |      |      |      | 100% | 98.5%| 100% |      |      |      |
| Vanco          |      |      |      | 100% | 98.5%| 100% |      |      |      |
| ESBL           |      |      |      | 100% | 94.7%| 45% | nil  | nil  | nil  |

Table 4: Bacterial profile of Soft tissue/Wound Infection

|                | 2013 | 2014 | 2015 | TOTAL |
|----------------|------|------|------|-------|
| Total Number of Samples received | 200  | 238  | 528  | 966   |
| Organisms      | NO   | %    | NO   | %    | NO   | %    | NO   | %    |
| Gram Negative bacilli |      |      |      |       |
| E.coli         | 56   | 22%  | 19   | 6%   | 90   | 15.2%| 165  | 14.1%|
| Klebsiella     | 20   | 8%   | 13   | 4%   | 33   | 5.6% | 66   | 5.6% |
| Proteus        | 12   | 4.8% | 37   | 11.3%| 84   | 14.2%| 133  | 11.3%|
| Citrobacter    | 4    | 1.6% | 4    | 1.2% | 19   | 3.2% | 27   | 2.3% |
| Non fermenting GNB |      |      |      |       |
| Pseudomo       | 48   | 19%  | 76   | 23.2%| 168  | 28.4%| 292  | 25.3%|
| Other NFGNB    | 11   | 4.4% | 21   | 6.3% | 13   | 2.2% | 45   | 3.8% |
| Acinetobacter  | 10   | 4%   | 4    | 1.2% | -    | -    | 14   | 1.2% |
| Gram positive cocci |      |      |      |       |
| Staph aureus   | 72   | 28.4%| 122  | 37%  | 116  | 19.6%| 310  | 26.4%|
| CONS           | 12   | 4.8% | 32   | 9.8% | 52   | 8.8% | 96   | 8.2% |
| Enterococci    | 7    | 3%   | 1    | 0.3% | 17   | 2.8% | 25   | 2.1% |
| TOTAL          | 252  | 328  | 592  | 1172  |
**Table 5** Antibiogram for three year period (Jan 2013 – Dec 2015) of three prevalent Wound infection pathogen Microbiology Data – (n-1172)

| Most Common Pathogens       | Number of Isolate | Prevalence % | Antibiotic Sensitivity %                                                                 |
|-----------------------------|-------------------|--------------|----------------------------------------------------------------------------------------|
| *Pseudomonas*               | 292               | 25.3%        | Amik-84%, Genta-62%, Cefotax-%, Ceftaz-64.%, Cipro-67%, Pip taz-85.3%, Imipenem & Colistin-100%. **MDR-30.1%** |
| *E.coli*                    | 165               | 14.2%        | Amik-88%, Genta-38%, Cefotax-8%, Ceftaz-10%, Cipro-13.3%, Doxy-13.3%, Pip taz-82%, Imipenem - 94% & Colistin-99% **ESBL-90.3%** |
| Staphylococcus aureus       | 310               | 26.4%        | Genta-68.3%, Cefazolin-64%, Cefotaxime-71%, Cepoxitin-73 5Cipro-46%, Erythro-63.2%, Clinda-78%, Linezolid-99.4%, Vanco-98.7% **MRSA-27%** |

**Table 6** Trending Sensitivity pattern of three prevalent wound infection Pathogen for three year study period

|                      | *Pseudomonas*-25.3% (292-Isolates) | *E.coli*-14.2% (165-Isolates) | Staphylococcus*-26.4% (310-Isolates) |
|----------------------|-----------------------------------|-------------------------------|--------------------------------------|
| No of isolates       | 2013     | 2014 | 2015 | 2013 | 2014 | 2015 | 2013 | 2014 | 2015 | 2013 | 2014 | 2015 |
| Amikacin             | 75%      | 68%  | 92%  | 67%  | 89.4% | 100% | 72    | 122  | 116  |
| Genta                | 41.6%    | 59.2% | 69%  | 29%  | 42.1% | 42.2% | 56%  | 67.2% | 78%  |
| Cefazolin            | -        | -    | -    | 7%   | 10.5% | 4.4%  | 56%  | 57%  | 43.1%|
| Cefotax              | -        | -    | -    | 11%  | 15.7% | 4.4%  | 78%  | 62.3%| 56.8%|
| Ceftazidime          | 58%      | 56.5% | 69%  | 11%  | 31.5% | 4.4%  | 13.8%| 46%  | 67.2%|
| Cipro                | 58%      | 67.1% | 69%  | 7%   | 31.5% | 13.3% | 16.6%| 51%  | 78%  |
| Oflox                | 75%      | 70.4% | 70.2% | 7%   | 42.1% | 15.5% | 35%  | 66%  | 91.4%|
| Doxy                 | -        | -    | -    | 14%  | 21%   | 22%   | 56%  | 64%  | 67.2%|
| Imipenem             | 100%     | 100% | 100% | 100% | 100%  | 88.8% | 97%  | 100% | 100% |
| Pi-Taz               | 75%      | 100% | 82%  | 75%  | 89%   | 78%   | 97%  | 95%  | 100% |
| Colistin             | 83.3%    | 100% | 91.6%| 100% | 100%  | 98%   | 97%  | 100% | 100% |
| Erythro              |                      |                  |                                  | 56% | 64%  | 67.2% |
| Clinda               |                      |                  |                                  | 67% | 85.2%| 78%  |
| Linezolid            |                      |                  |                                  | 97% | 100%| 100% |
| Vanco                |                      |                  |                                  | 97% | 95%  | 100% |
| **MDR**              | 41.6%    | 34.2% | 13.1%|                      |       |       |       |
| **ESBL**             |                      | 89%  | 68%  | 96%  |       |       |       |
| **MRSA**             |                      | 40%  | 25%  | 20%  |       |       |       |
Table 7 Bacterial profile of Respiratory Tract Infection

| Organisms | 2013 | 2014 | 2015 | TOTAL |
|-----------|------|------|------|-------|
| **Total Number of Samples received** | 429  | 659  | 1310 | 2398  |
| **Organisms** | **NO** | **%** | **NO** | **%** | **NO** | **%** | **No** | **%** |
| **Gram Negative bacilli** | | | | | | | | |
| *Klebsiella* | 56   | 26.3%| 72   | 30.5%| 211   | 43.2%| 339   | 36.1% |
| *E.coli* | 10   | 4.7% | 9    | 3.8% | 9     | 1.8% | 28    | 2.9%  |
| *citrobacter* | 1    | 0.5% | -    | -    | 9     | 1.8% | 10    | 1.1%  |
| **Non fermenting GNB** | | | | | | | | |
| *Pseudomonas* | 36   | 17%  | 47   | 20%  | 127   | 26.0%| 210   | 22.4% |
| *Acinetobact* | 40   | 18.7%| 23   | 9.7% | 9     | 1.8% | 72    | 7.7%  |
| *Other NFGNB* | 11   | 5.2% | 27   | 11.4%| 34    | 7.0% | 72    | 7.7%  |
| **Gram positive cocci** | | | | | | | | |
| *Staph aureus* | 30   | 14%  | 24   | 10.2%| 18    | 3.7% | 72    | 7.7%  |
| *CONS* | 3    | 1.3% | 6    | 2.5% | 9     | 1.8% | 18    | 2.0%  |
| *Enterococci* | 2    | 1%   | 1    | 0.5% | 4     | 0.8% | 7     | 0.7%  |
| *Streptococci* | 24   | 11.3%| 27   | 11.4%| 59    | 12.1%| 110   | 11.7% |
| **TOTAL** | 213  | 236  | 489  | 938   |

Table 8 Antibiogram for three year period (Jan 2013 – Dec 2015) of three prevalent Respiratory tract Infection pathogen Microbiology Data – (n=938)

| Most Common Pathogens | Number of Isolate | Prevalence % | Antibiotic Sensitivity % |
|-----------------------|-------------------|--------------|--------------------------|
| *Klebsiella*          | 339               | 36.1%        | Amik-95%, Genta-63%, Cefotax 53%, Ceftaz-50%, Cipro-76%, Doxy-68%, Pip taz-100%, Imipenem-98.5%, Colistin-100% ESBL-50% |
| *Pseudomonas*         | 210               | 22.4%        | Amik-99%, Genta-88%, Ceftaz-90%, Cipro-90%, Pip taz-98%, Imipenem-98.5% & Colistin-99.5%, MDR-10.5% |
| Staphylococcus aureus | 72                | 7.7%         | Genta-83%, Cefazolin-74%, Cefotaxime-86%, Cipro-57%, Erythro-73.6%, Clinda-89%, Linezolid-100%, Vanco-100% MRSA-17% |
Table 9: Trending Sensitivity pattern of three prevalent Respiratory Pathogen for three year study period

|                  | Klebsiella-36.1% (339-isolates) | Pseudomonas-22.4% (210- isolates) | Staphylococcus-7.7% (72- isolates) |
|------------------|---------------------------------|-----------------------------------|-----------------------------------|
| **No of isolates** | 2013 2014 2015                  | 2013 2014 2015                    | 2013 2014 2015                    |
|                  | 56 72 211                        | 36 47 127                         | 30 24 18                          |
| Amikacin         | 96.4% 90% 96.1%                 | 100% 96% 100%                     | 60% 100% 100%                     |
| Gentamycin       | 89.3% 60% 56.2%                 | 81% 85% 91%                       | 60% 100% 100%                     |
| Amikacin         | 14.3% 50.3% 64.4%               | 86% 85% 93%                       | 80% 91.6% 89%                     |
| Cefotax          | 11% 37% 64.2%                   | 86% 85% 93%                       | 60% 100% 100%                     |
| Ceftazidime      | 80.3% 60% 80%                   | 81% 85% 94%                       | 50% 50% 78%                       |
| Cipro            | 45% 50.3% 68.2%                 |                                | 50% 66.6% 89%                     |
| Impenem         | 100% 97.2% 100%                 | 97.2% 95.7% 100%                  | 100% 100% 100%                    |
| Cefazolin        | 14.3% 50.3% 64.4%               | 86% 85% 93%                       | 80% 91.6% 89%                     |
| Cefotax          | 11% 37% 64.2%                   | 86% 85% 93%                       | 60% 100% 100%                     |
| Cipro            | 80.3% 60% 80%                   | 81% 85% 94%                       | 50% 50% 78%                       |
| Doxy             | 45% 50.3% 68.2%                 |                                | 50% 66.6% 89%                     |
| Imipenem         | 100% 97.2% 100%                 | 97.2% 95.7% 100%                  | 100% 100% 100%                    |
| Erythromycin     | 100% 100% 100%                  | 100% 100% 100%                    | 100% 100% 100%                    |
| MRSA %           | 21% 17% 11%                     | 21% 17% 11%                       | 21% 17% 11%                       |
| ESBL %           | 89% 63% 36%                     | 89% 63% 36%                       | 89% 63% 36%                       |
| MDR              | 10.8% 17.1% 7.1%                | 10.8% 17.1% 7.1%                  | 10.8% 17.1% 7.1%                  |

Table 10: Bacterial profile of Urinary Tract Infection

|                  | 2013 | 2014 | 2015 | TOTAL |
|------------------|------|------|------|-------|
| Total Number of Samples received | 929  | 1377 | 2636 | 4942  |
| Organisms        | NO % | NO % | NO % | NO %  |
| Gram Negative bacilli |      |      |      |       |
| E.coli            | 139  | 34.8%| 211  | 35.5% | 600  | 54%  | 950  | 45%  |
| Klebsiella        | 82   | 20.4%| 129  | 21.7% | 147  | 13.2%| 358  | 17%  |
| Proteus           | 9    | 2.6% | 22   | 3.6%  | 28   | 2.5% | 59   | 2.8% |
| Citrobacte        | 17   | 4%   | 33   | 5.6%  | 19   | 1.7% | 69   | 3.3% |
| Non fermenting GNB |      |      |      |       |
| Pseudo            | 43   | 10.8%| 33   | 5.6%  | 56   | 5%   | 132  | 6.3% |
| Acinetobacter     | 4    | 1.1% | 11   | 1.9%  | -    | -    | 15   | 0.7% |
| Other NFGNB       | -    | -    | -    | -     | 38   | 3.4% | 38   | 1.8% |
| Gram positive cocci |     |      |      |       |
| Staph             | 1    | 0.3% | 0    | -     | 28   | 2.5% | 29   | 1.4% |
| CONS              | 65   | 16.2%| 44   | 7.4%  | 66   | 6%   | 175  | 8.3% |
| Enterococci       | 39   | 9.8% | 111  | 18.7% | 130  | 11.7%| 280  | 13.4% |
| TOTAL             | 399  | 594  | 1112 | 2105  |
**Table.11** Anti-biogram for three year period (Jan 2013 – Dec 2015) of three prevalent Urinary tract Infection pathogen Microbiology Data – (n- 2105)

| Most Common Pathogens | Number of Isolate | Prevalence % | Antibiotic Sensitivity % |
|-----------------------|-------------------|--------------|--------------------------|
| **E.coli**            | 950               | 45%          | Amik-84.4%, Gent-35.3%, Ceftaz-25.7%, Ceftriaxone-24.3%, Norflo-22 %, Nitrofurantoin-93.2%, Cotrimox-26.3 %, Piprazem-92.5 %, Imipenem -97.5% & Colistin-100% ESBL-74.3% |
| **Klebsiella**        | 358               | 17%          | Amik-82 %, Gent-34%, Ceftaz-23.2 %, Ceftriaxone-25.1%, Norflo-31.3 %, Nitrofurantoin-72%, Cotrimox-35 %, Piprazem-100 %, Imipenem -97.2% & Colistin-99.4% ESBL-76.8% |
| **Enterococci**       | 280               | 13.4%        | Pen-15.4%, Amp-27.5%, Cefazolin-38.2%, Norflo-33.9%, Nitrofurantoin-36.4%, Linezolid-97.9%, HCG-48.9%, Vancoc-98.9% VRE-1.1% |

**Table.12** Trending Sensitivity pattern of three prevalent Urinary Tract infection pathogen for three year study period

|          | **E.coli -45% (950-isolates)** | **Klebsiella -17% (358 -isolates)** | **Enterococci-13.4% (280-isolates)** |
|----------|---------------------------------|-------------------------------------|--------------------------------------|
|          | 2013 | 2014 | 2015 | 2013 | 2014 | 2015 | 2013 | 2014 | 2015 |
| No of isolated | 139  | 211  | 600  | 82   | 129  | 147  | 39   | 111  | 130  |
| Amikacin     | 81%  | 90%  | 90%  | 59%  | 78%  | 100% |      |      |      |
| Genta/HCG    | 41%  | 29%  | 37%  | 63%  | 30%  | 20%  | 23%  | 30%  | 73%  |
| Cefazolin    |      |      |      |      |      |      |      |      |      |
| Ceftriaxone  | 7%   | 42%  | 22%  | 22%  | 32%  | 19.7%| 20%  |      |      |
| cefiazem     | 12%  | 42%  | 23%  | 22%  | 27%  | 20.4%|      |      |      |
| Nor flox     | 16%  | 24%  | 22%  | 22%  | 27%  | 20.4%| 34%  | 35%  | 33%  |
| Nitro furan  | 84%  | 97%  | 94%  | 48%  | 78%  | 40.1%| 23%  | 25%  | 50%  |
| Cotrimoxazol | 19%  | 29%  | 27%  | 32%  | 30%  | 10.2%|      |      |      |
| Imepene      | 100% | 100% | 96%  | 89%  | 100% | 100% |      |      |      |
| Pip-Taz      | 81%  | 90%  | 96%  | 100% | 100% | 100% |      |      |      |
| Colistin     | 100% | 100% | 100% | 97%  | 100% | 100% |      |      |      |
| Linezolid    |      |      |      |      |      |      |      |      |      |
| Vanco        |      |      |      |      |      |      |      |      |      |
| ESBL %       | 78%  | 58%  | 77%  | 78%  | 73%  | 80%  |      |      |      |
Studies by Eswarappa et al., (2011) Aswani et al., (2014) Verma et al., (2016) Syed et al., (2012) & Lathika et al., (2015) reported E.coli & Klebsiella as predominant Uropathogens. Aswani et al., showed enterococci as prevalent gram positive pathogen. All the studies except Lathika et al., reported good susceptibility profile for common antibiotics tested for UTI when compared to our study.

During the reference period overall there was a decrease in prevalence of drug resistant pathogens irrespective of specimen type. Vancomycin resistant Enterococci decreased from 6% in 2013 to 1.2% in 2015, MRSA reduced from 41% in 2013 to 20% in 2015, ESBL Klebsiella pneumonia from 89% in 2013 to 51% in 2015, Carbapenam resistant Klebsiella reduced from 4.7% to 0.5%, MDR Acinetobacter from 52% in 2013 to 25% in 2015, Carbapenam resistant Acinetobacter from 28% to 25%, MDR Pseudomonas from 37% to 12%, carbapenam resistant Pseudomonas from 2.4% in 2013 to 1.8% in 2015, Carbapenam resistant E.coli increased from 0% to 4.7%. With reference to individual prevalent pathogens, there was a low susceptibility profile for E.coli for both wound infections and UTI. Klebsiella had better susceptibility profile for respiratory infections when compared to blood stream infections & UTI. Pseudomonas showed improved susceptibility profile for Respiratory infection when compared to wound infections. Staphylococcus aureus showed better susceptibility profile for both wound & respiratory infections.

In conclusion, during the reference period though, there was increase in sensitivity percentage for most of the antibiotics during the prospective period when compared to retrospective period a narrow spectrum of sensitivity was observed for commonly used antibiotics. An empirical antimicrobial Guideline was drafted following retrospective antibiogram Surveillance. Following retrospective period an educational intervention with specific reference to Infection control measures & antimicrobial stewardship had proven to be modestly effective in our study.

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