

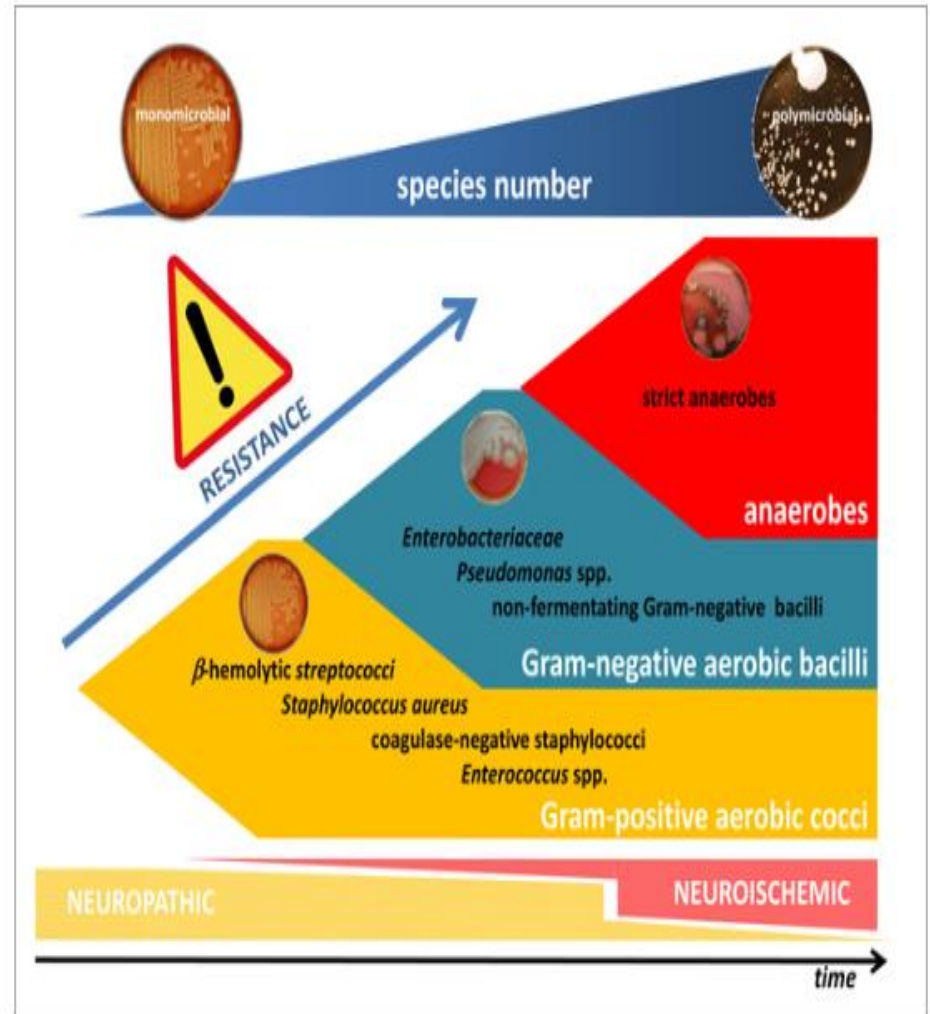
# Dünyada ve ülkemizde etken değişimi

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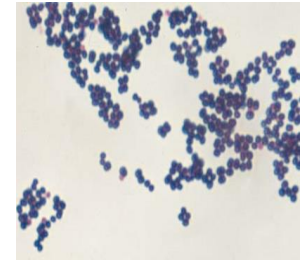
# DAİ mikroorganizmalar

- Nöropati başlangıcı ve akut dönemde monomikrobiyal
- Kronik ve uzun süren yaralarda polimikrobiyal



# DAİ etken mikroorganizmalar

- ❖ Hastanın özelliklerine
  - Eşlik eden hastalıklar (KBY, malignensi, immün supresyon.. )
  - Antibiyotik kullanım öyküsü
  - Son 3 ay içinde hastaneye yatış öyküsü
  - Bakım merkezinde kalma ...
- ❖ Yaranın boyut ve derinliğine
- ❖ Bölgesel epidemiyolojik veriler göre değişir.



# DAİ etken deęiřimi

- Tanı testlerinde gelişmeler
- Direnç mekanizmalarının tanımlanması
- Biofilm, biofilm oluşturan mikroorganizmaların gösterilmesi



# Mikroorganizmaların tanımlanması

## Gram boyama ve kültür

- Derin doku, aspirat, kemik
- 2-3 günde sonuç
- Zor üreyen etkenler için sensitivitesi düşük
- Antibiyotik tedavisi alan hastada negatiflik

## Moleküler yöntemler

- Çok sayıda mikroorganizma tanımlanması
- Zor üreyen etkenler
- Zorunlu anaeroblar
- Kısa sürede sonuç
- Maliyet
- Her lab yapılamıyor
- Patojenik olmayan türler de tanımlanmakta

# Microbiology of diabetic foot infections: from Louis Pasteur to 'crime scene investigation'

Anne Spichler<sup>1</sup>, Bonnie L Hurwitz<sup>2</sup>, David G Armstrong<sup>3</sup> and Benjamin A Lipsky<sup>4,5\*</sup>

- PCR
- (bakteri 16sRNA, mantar 18srRNA)
- Virülans genleri
- Metagenomik metodlar
  - patojenin adı,
  - virülans ve antibiyotik duyarlılığını
  - mikrobiom tanımlar( Bakteri, virüs, mantar)

## Molecular and culture based assessment of bacterial pathogens in subjects with diabetic foot ulcer

Saba Noor<sup>a</sup>, Alok Raghav<sup>a,1</sup>, Iqbal Parwez<sup>b</sup>, Maaz Ozair<sup>a</sup>, Jamal Ahmad<sup>a,\*</sup>

50 örnekte

37 (%74) kültür

45 (%90) PCR pozitif

Ülser

Evre 1 : %24

Evre 2: %30

Evre 3: %28

Evre 4: %18

%46 OM var.

| Mikroorganizma       | Kültür (n:44) | PCR (n:65) |
|----------------------|---------------|------------|
| <i>S. aureus</i>     | 12 (%27.2)    | 18 (%27.6) |
| <i>K.pneumoniae</i>  | 18 (%40.9)    | 28(%44.6)  |
| <i>P. aeruginosa</i> | 8 (%18.1)     | 13(%20)    |
| <i>E. coli</i>       | 6(%13.6)      | 6(%9.2)    |

# Comparison of Culture and Molecular Identification of Bacteria in Chronic Wounds

Daniel D. Rhoads <sup>1,2</sup>, Randall D. Wolcott <sup>1,3,4,\*</sup>, Yan Sun <sup>3</sup> and Scot E. Dowd <sup>3,4</sup>

168 kronik yara

24 dekübit

40 DAİ

23 cerrahi alan

49 venöz ülser

32 travma

40 DAİ (en sık 5 etken)

Kültür

Moleküler (PCR)

Enterokok

Anaerococcus

Pseudomonas

Peptoniphilus

Streptokok

Corynbacterium

Serratia

Finegoldia

Stafilokok

Pseudomonas

Bu çalışmada kronik yarada  
Kültür ile **17**, moleküler testlerle **338**  
Aynı yarada kültürle **3**, moleküler test **33** farklı  
bakteri tanımlanmış.



# Dünyada DAI etkenleri

# Diabetic foot infection: a critical review of recent randomized clinical trials on antibiotic therapy

- Ocak 1999-Aralık 2009
- 14 çalışma, 3119 hasta

Gram (+) % 41.6 - 86

Gram (-) % 7- 50.6

*Staphylococcus spp* % 22.5 - 59

*P. aeruginosa* %2.5 - 14.6

| Pathogens isolated (%)                 | Stevens, <sup>6</sup><br>1999 <sup>a</sup><br>(n=637) | Siami, <sup>7</sup><br>2001 <sup>b</sup><br>(n=353) | Graham, <sup>8</sup><br>2002 <sup>b</sup><br>(n=320) | Graham, <sup>9</sup><br>2002 <sup>b</sup><br>(n=609) | Lipsky, <sup>10</sup><br>2004<br>(n=400) | Clay, <sup>11</sup><br>2004<br>(n=87) | Lipsky, <sup>12</sup><br>2005 <sup>a</sup><br>(n=123) | Lipsky, <sup>13</sup><br>2005<br>(n=714) | Harkless, <sup>14</sup><br>2005<br>(n=273) | Giordano, <sup>15</sup><br>2005 <sup>b</sup><br>(n=338) | Lipsky, <sup>16</sup><br>2007<br>(n=111) | Noel, <sup>17</sup><br>2008<br>(n=205) | Lipsky, <sup>18</sup><br>2008<br>(n=1008) | Saltoglu, <sup>19</sup><br>2009<br>(n=89) |
|----------------------------------------|-------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------|---------------------------------------|-------------------------------------------------------|------------------------------------------|--------------------------------------------|---------------------------------------------------------|------------------------------------------|----------------------------------------|-------------------------------------------|-------------------------------------------|
| <b>Gram-pos aerobic cocci</b>          | 100.0                                                 | 69.7                                                | 65.3                                                 | 48.4                                                 | 71.3                                     | 86.0                                  | 100.0                                                 | 41.6                                     | 74.7                                       | 65.4                                                    | 71.2                                     | 58.5                                   | 77.3                                      | 42.7                                      |
| <i>Staphylococcus sp</i>               | 67.0                                                  | 39.4                                                | 35.3                                                 | 25.9                                                 | 46.3                                     | 59.0                                  | 45.5                                                  | NS                                       | NS                                         | NS                                                      | NS                                       | NS                                     | 34.7                                      | 22.5                                      |
| <i>S. aureus</i>                       | 46.2                                                  | 39.4                                                | 35.3                                                 | 23.3                                                 | 32.8                                     | 36.0                                  | 44.7                                                  | 20.6                                     | 48.4                                       | 36.4                                                    | 30.6                                     | 48.8                                   | 30.1                                      | 6.5                                       |
| MSSA                                   | NS                                                    | 32.3                                                | 32.8                                                 | 2.2                                                  | 26.5                                     | NS                                    | 36.6                                                  | 18.6                                     | 37.8                                       | 31.4                                                    | NS                                       | 36.1                                   | NS                                        | NS                                        |
| MRSA                                   | NS                                                    | 7.1                                                 | 2.5                                                  | 1.1                                                  | 6.3                                      | NS                                    | 8.1                                                   | 2.0                                      | 10.6                                       | 5.0                                                     | NS                                       | 12.7                                   | NS                                        | NS                                        |
| <i>Streptococcus sp</i>                | 29.4                                                  | 19.8                                                | 15.0                                                 | 19.4                                                 | 12.3                                     | 16.0                                  | 31.7                                                  | 6.4                                      | 17.6                                       | 20.1                                                    | 27.0                                     | 9.8                                    | 17.9                                      | 8.9                                       |
| <i>Enterococcus sp</i>                 | 3.6                                                   | 10.5                                                | 6.6                                                  | 3.1                                                  | 12.8                                     | 11.0                                  | 22.8                                                  | 6.7                                      | 8.8                                        | 8.9                                                     | 13.5                                     | NS                                     | 24.6                                      | 11.2                                      |
| <b>Gram-pos aerobic bacilli</b>        | NS                                                    | NS                                                  | NS                                                   | 0.3                                                  | NS                                       | NS                                    | NS                                                    | NS                                       | NS                                         | NS                                                      | NS                                       | NS                                     | NS                                        | 0                                         |
| <b>Gram-neg aerobic bacilli</b>        | NI                                                    | 27.2                                                | 27.8                                                 | 22.3                                                 | 28.8                                     | 7.0                                   | NI                                                    | 16.5                                     | 15.0                                       | 15.1                                                    | 16.2                                     | 41.5                                   | 21.2                                      | 50.6                                      |
| <i>Enterobacteriaceae</i>              | NI                                                    | 17.6                                                | 13.4                                                 | 16.9                                                 | 22.0                                     | 7.0                                   | NI                                                    | 10.1                                     | 10.3                                       | 15.1                                                    | 9.0                                      | 33.7                                   | 13.6                                      | 32.6                                      |
| <i>Escherichia coli</i>                | NI                                                    | 4.8                                                 | 2.5                                                  | 5.2                                                  | NS                                       | NS                                    | NI                                                    | NS                                       | 1.8                                        | 5.9                                                     | 2.7                                      | 9.3                                    | 3.5                                       | 7.9                                       |
| <i>Proteus mirabilis</i>               | NI                                                    | 2.8                                                 | 6.9                                                  | NS                                                   | NS                                       | 7.0                                   | NI                                                    | NS                                       | 3.7                                        | 3.3                                                     | 6.3                                      | 6.8                                    | 4.1                                       | 5.6                                       |
| <i>Stenotrophomonas maltophilia</i>    | NI                                                    | NS                                                  | NS                                                   | NS                                                   | NS                                       | NS                                    | NI                                                    | NS                                       | NS                                         | NS                                                      | NS                                       | NS                                     | 1.9                                       | 0                                         |
| <i>Pseudomonas aeruginosa</i>          | NI                                                    | 9.6                                                 | 4.1                                                  | 2.5                                                  | 6.8                                      | NS                                    | NI                                                    | 3.2                                      | 4.8                                        | NS                                                      | NS                                       | 7.8                                    | 5.8                                       | 14.6                                      |
| <b>Gram-pos anaerobic cocci</b>        | NI                                                    | NS                                                  | 2.2                                                  | 10.2                                                 | NS                                       | NS                                    | NI                                                    | 19.0                                     | NS                                         | 6.5                                                     | NS                                       | NS                                     | NS                                        | 0                                         |
| <i>Peptostreptococcus spp</i>          | NI                                                    | NS                                                  | NS                                                   | 8.7                                                  | NS                                       | NS                                    | NI                                                    | 12.2                                     | NS                                         | 6.5                                                     | 4.5                                      | NS                                     | NS                                        | 0                                         |
| <b>Gram-pos anaerobic bacilli</b>      | NI                                                    | NS                                                  | NS                                                   | 2.6                                                  | NS                                       | NS                                    | NI                                                    | 5.9                                      | NS                                         | NS                                                      | NS                                       | NS                                     | NS                                        | 0                                         |
| <b>Gram-neg anaerobic bacilli</b>      | NI                                                    | 3.1                                                 | 4.7                                                  | 16.1                                                 | NS                                       | 7.0                                   | NI                                                    | 11.2                                     | MS                                         | 13.0                                                    | 8.1                                      | NS                                     | NS                                        | 1.1                                       |
| <i>Bacteroides fragilis</i>            | NI                                                    | 3.1                                                 | NS                                                   | 3.9                                                  | NS                                       | NS                                    | NI                                                    | NS                                       | NS                                         | 5.6                                                     | 1.8                                      | NS                                     | 1.5                                       | NS                                        |
| <b>Gram-neg anaerobic coccobacilli</b> | NI                                                    | NS                                                  | NS                                                   | NS                                                   | NS                                       | NS                                    | NI                                                    | 5.7                                      | NS                                         | NS                                                      | NS                                       | NS                                     | NS                                        | 0                                         |
| <b>Polymicrobial infections</b>        | NS                                                    | 55.0                                                | 40.0                                                 | NS                                                   | 30.5                                     | NS                                    | 28.2                                                  | 46.5                                     | 29.5                                       | 47.7                                                    | NS                                       | 11.0                                   | NS                                        | 40.3                                      |

# Pseudomonas aeruginosa

## An Uncommon Cause of Diabetic Foot Infection

112 hasta ,ABD

**Streptokok spp** %48.2

***S. aureus*** %42.9

**KNS** %42.9

Enterobacteriaceae %21.4

*P. aeruginosa* %4.5

Young H et al. J Am Podiatr Med Assoc 2015;(2):  
125-9

Çok merkezli, prospektif, 433 hasta, ABD

1145 aerob bakteriler

***Staphylococcus spp*** % 34 (389)

*S. aureus* %18.7

**Streptokok spp** %15.5 (177)

Enterokok spp % 13.5 (155)

Gr(-) bakteriler %19.7(225)

*Pseudomonas spp* %3.5 (40)

462 anaerob

Citron DM et al. J of Clin Microbiology 2007; 2819-28.

# Bacterial Profile and Antibiotic Resistance in Patients with Diabetic Foot Ulcer in Guangzhou, Southern China: Focus on the Differences among Different Wagner's Grades, IDSA/IWGDF Grades, and Ulcer Types

2010-2015, 232 izolat, Çin  
2017 bakteri, 25 mantar

## Bakteriler

Gram (+) % 54.1

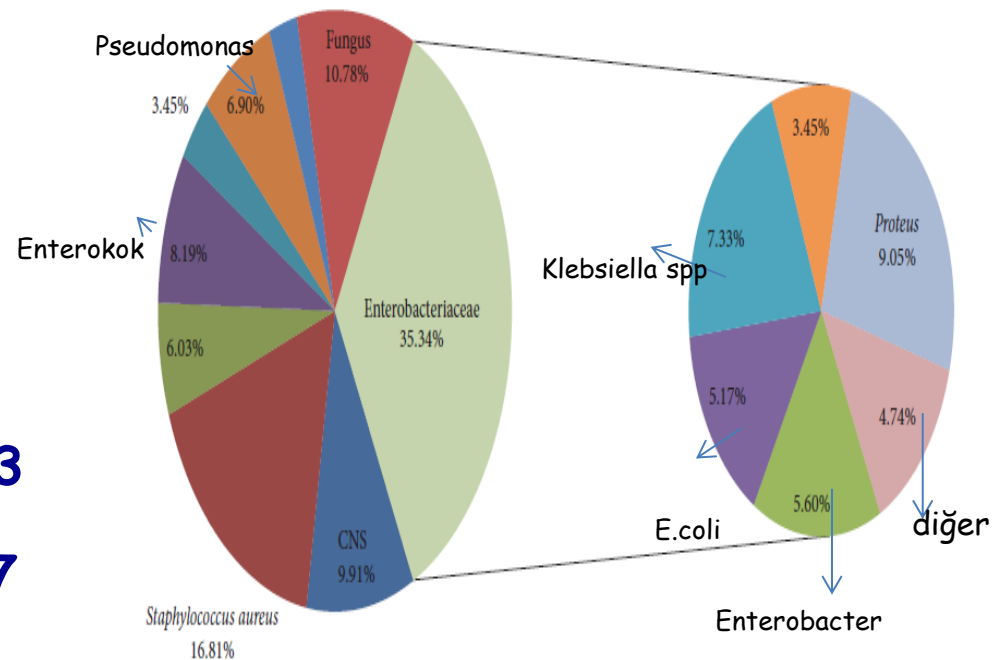
Gram (-) % 45.9

✓ *Enterobacteriaceae* % 35.3

✓ *Staphylococcus spp* % 26.7

✓ *S. aureus* %16.8

✓ *Proteus spp* %9



# Clinical Characteristics and Risk Factors of Diabetic Foot Ulcer With Multidrug-Resistant Organism Infection

1 yıl, retrospektif, Çin

157 hasta, 146 izolat

- Gram (-) bakteri 72 (% 49)
- Gram (+) bakteri 74 (%51)

En sık etkenler:

- *Enterobacter spp* 36 (%24.6)
- *S. aureus* 18 (%12.3 )
- *S. epidermidis* 16 (%11)
- *P. aeruginosa* 16 (%11)

78 izolat

(%53.4 ) MDR

- *S. aureus* (%16.7)
- *Enterobacter spp* (%16.7)
- *P. aeruginosa* (%15.4)

## Changing microbiological profile of pathogenic bacteria in diabetic foot infections: time for a rethink on which empirical therapy to choose?

Hindistan, tek merkez, 434 hasta

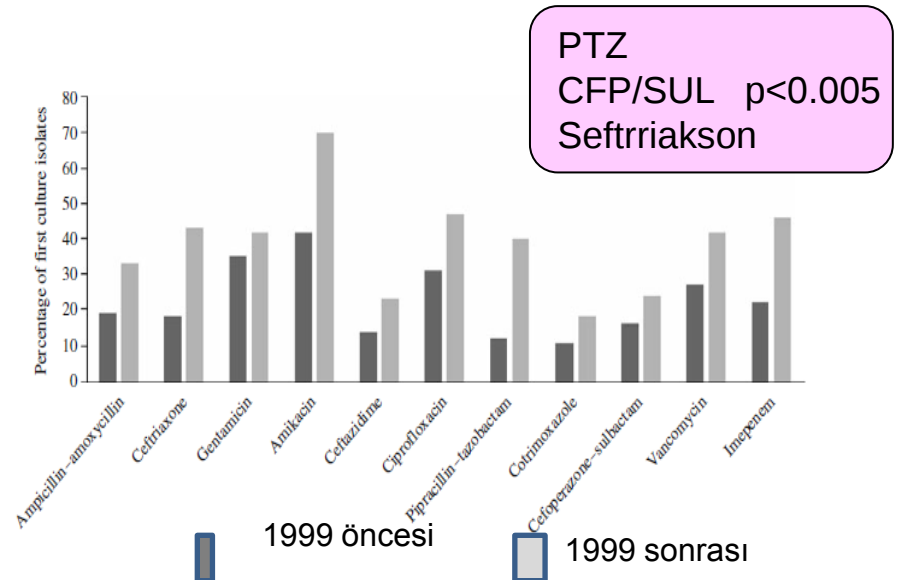
1991-2008, 1999 öncesi ve sonrası karşılaştırılmış.

Polimikrobiyal %66 ,  
monomikrobiyal %23,

Etkenler

|                      |        |
|----------------------|--------|
| <i>P. aeruginosa</i> | % 20.1 |
| <i>S. aureus</i>     | % 17.2 |
| <i>E. coli</i>       | % 16.3 |

MDR %81,  
GSBL oranı %56  
MRSA %25

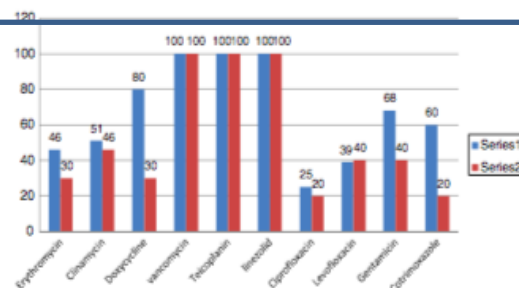


# Epidemiology of diabetic foot infections in a reference tertiary hospital in India

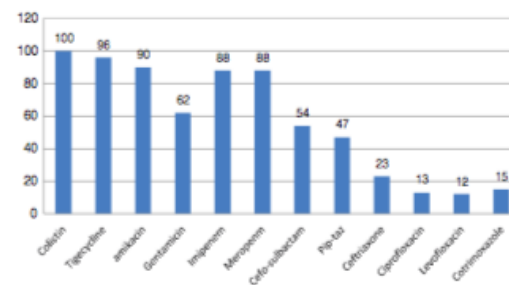
2014, 6 aylık, prospektif, 261 hasta 289 izolat

**Table 3 – Bacterial pathogens in diabetic foot infection.**

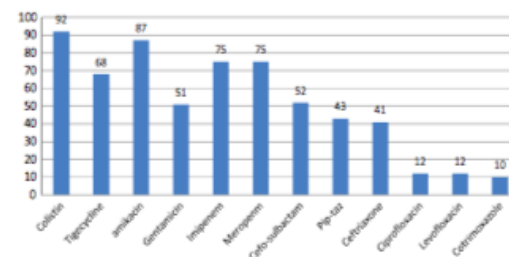
| Name of the pathogen                | Number of pathogen |
|-------------------------------------|--------------------|
| <i>Staphylococcus aureus</i>        | 76 (26.9%)         |
| <i>Pseudomonas aeruginosa</i>       | 59 (20.9%)         |
| <i>Enterococcus faecalis</i>        | 36 (12.7%)         |
| <i>Escherichia coli</i>             | 34 (12%)           |
| <i>Klebsiella pneumoniae</i>        | 27 (9.5%)          |
| <i>Citrobacter koseri</i>           | 10 (3.5%)          |
| <i>Proteus mirabilis</i>            | 9 (3.1%)           |
| <i>Enterobacter cloacae</i>         | 8 (2.8%)           |
| <i>Citrobacter freundii</i>         | 5 (1.7%)           |
| <i>Streptococcus pyogenes</i>       | 5 (1.7%)           |
| <i>Proteus vulgaris</i>             | 4 (1.4%)           |
| <i>Enterobacter aerogenes</i>       | 2 (0.7%)           |
| <i>Acinetobacter baumannii</i>      | 2 (0.7%)           |
| <i>Proteus penneri</i>              | 1 (0.3%)           |
| <i>Providencia stuartii</i>         | 1 (0.3%)           |
| <i>Serratia marcescens</i>          | 1 (0.3%)           |
| <i>Acinetobacter lwoffii</i>        | 1 (0.3%)           |
| <i>Stenotrophomonas maltophilia</i> | 1 (0.3%)           |
| <b>Total</b>                        | <b>282</b>         |



**Fig. 1 – Susceptibility pattern of *Staphylococcus aureus*.**

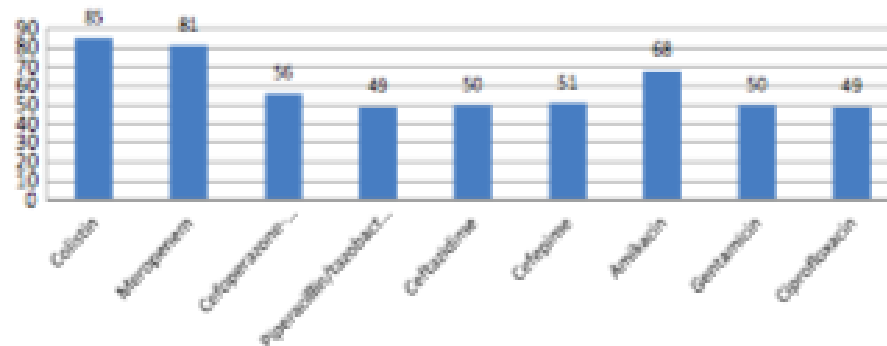


**Fig. 2 – Susceptibility pattern of *E. coli*.**



**Fig. 3 – Susceptibility pattern of *Klebsiella pneumoniae*.**

- **MRSA** % 23.7
- **VR *E. faecalis*** % 11
- **Karbapenem direnci**  
Enterobacteriaceae % 16.8  
*P. aeruginosa* % 18.6
- **Kolistin direnci**  
*K. pneumoniae* %7.4  
*P. aeruginosa* %15
- **GSBL *E. coli*** %61.7  
*K. pneumoniae* %33.3
- **KPC *K. pneumoniae*** % 25.9



**Fig. 4 – Susceptibility pattern of *P. aeruginosa*.**

**Table 4 – Phenotypic detection of resistance mechanisms in beta-lactam resistance Enterobacteriaceae (n: 95).**

|                                       | ESBL       | AmpC     | CRE        | MHT           | EDS         |
|---------------------------------------|------------|----------|------------|---------------|-------------|
| <i>Klebsiella pneumoniae</i> (n = 27) | 9 (33.3%)  | –        | 7 (25.9%)  | 5 (1-NDM +ve) | 4 (NDM +ve) |
| <i>Escherichia coli</i> (n = 34)      | 21 (61.7%) | 2 (5.8%) | 3 (8.8%)   | 2             | 1 (NDM +ve) |
| <i>Enterobacter cloacae</i> (n = 8)   | 4 (50%)    | –        | 2 (25%)    | –             | –           |
| <i>Enterobacter aerogenes</i> (n = 2) | 1 (50%)    | –        | 1 (50%)    | 1             | 0           |
| <i>Citrobacter koseri</i> (n = 10)    | 3 (30%)    | –        | –          | –             | –           |
| <i>Citrobacter freundii</i> (n = 5)   | 2 (40%)    | –        | –          | –             | –           |
| <i>Proteus mirabilis</i> (n = 9)      | 1 (11%)    | –        | 3 (33%)    | 1             | 2           |
| 95                                    | 41 (43.1%) | 2 (2.1%) | 16 (16.8%) | 9             | 7           |

+ve means positive.

# Microbiology and Antimicrobial Therapy for Diabetic Foot Infections

Ki Tae Kwon<sup>1</sup>, and David G. Armstrong<sup>2</sup>

- 2006-2017

Gram (+) aerob

% 57.5 - 80.6

Gram (-) basiller

%31.3 - 63.6

**Table 2.** Studies on causative microorganisms isolated from diabetic foot infections in Korea [28]

| Ist author (reference)                                                 | Choi SR [29]             | Seo YB [30]           | Lee DH [31]                  | Park SJ [32]             | Son ST [33]                   |
|------------------------------------------------------------------------|--------------------------|-----------------------|------------------------------|--------------------------|-------------------------------|
| Year                                                                   | 2006                     | 2007                  | 2009                         | 2009                     | 2017                          |
| Total number of enrolled patients                                      | 207                      | 74                    | 68                           | 140                      | 745                           |
| Number of patients with isolated strains/<br>with multiple strains (%) | 121 (58.4)/<br>40 (19.3) | 51 (68.9)/<br>6 (8.1) | 67 (98)/<br>31 (46.3)        | 113 (80.7)/<br>27 (19.3) | 613 (82.2)/<br>- <sup>a</sup> |
| Number of microorganisms (%) <sup>b</sup>                              |                          |                       |                              |                          |                               |
| <u>Gram-positive aerobes</u>                                           | <u>90 (74.4)</u>         | <u>39 (76.4)</u>      | <u>54 (80.6)<sup>c</sup></u> | <u>72 (63.7)</u>         | <u>478 (57.5)</u>             |
| MSSA                                                                   | 30 (24.8)                | 8 (15.6)              | 5 (7.5)                      | 35 (31)                  | 104 (12.5)                    |
| MRSA                                                                   | 26 (21.5)                | 15 (29.4)             | 19 (28.4)                    | 10 (8.8)                 | 114 (13.7)                    |
| Other <i>Staphylococcus</i> spp.                                       | 14 (11.6)                | 0                     | 11 (16.4)                    | 11 (9.7)                 | 29 (3.5)                      |
| <i>Streptococcus</i> spp.                                              | 10 (8.3)                 | 12 (23.5)             | 8 (11.9)                     | 0                        | 54 (6.5)                      |
| <i>Enterococcus</i> spp.                                               | 10 (8.3)                 | 3 (5.9)               | 10 (14.9)                    | 6 (5.3)                  | 118 (14.2)                    |
| Other Gram-positives                                                   | 0                        | 1 (2.0)               | 1 (1.5) <sup>c</sup>         | 10 (8.8)                 | 59 (7.1)                      |
| <u>Gram-negative aerobes</u>                                           | <u>77 (63.6)</u>         | <u>17 (33.3)</u>      | <u>21 (31.3)<sup>c</sup></u> | <u>41 (36.3)</u>         | <u>333 (40.0)</u>             |
| <i>Enterobacteriaceae</i>                                              | 47 (38.8)                | 7 (13.7)              | 10 (14.9) <sup>c</sup>       | 20 (17.6)                | 174 (21.0)                    |
| <i>Pseudomonas</i> spp.                                                | 18 (14.9)                | 4 (7.8)               | 11 (16.4)                    | 10 (8.8)                 | 78 (9.4)                      |
| <i>Acinetobacter</i> spp.                                              | 0                        | 2 (3.9)               | 0                            | 0                        | 13 (1.6)                      |
| Other Gram-negatives                                                   | 12 (9.9)                 | 3 (5.9)               | 0                            | 11 (9.7)                 | 68 (8.2)                      |
| Fungus                                                                 | 3 (2.5)                  | 1 (2.0)               | 1 (1.5) <sup>c</sup>         | 0                        | 9 (1.1)                       |
| Anaerobes                                                              | - <sup>a</sup>           | 0                     | - <sup>a</sup>               | 0                        | 12 (1.4)                      |

Kwon KT et al. Infect Chemother 2018;50(1):11-20

## Diabetic Foot Infection in Morocco: Microbiological Profile

2009-2014, Morocco

157 hasta, 307 bakteri

En sık etkenler;

➤ **Enterobacteriaceae %31.8**

➤ ***S. aureus* %12.6**

➤ Streptokok spp % 12.3

➤ Enterobacteriaceae'da

GSBL % 14.1

KPC % 3.8

➤ NFGB KPC % 38.5

➤ MRSA % 4.7

# Avrupa ülkeleri

- 2008-2010, Polonya

- 102 hasta, 199 bakteri

*E. faecalis* %16

*S. aureus* %15.5

KNS %11

*P. aeruginosa* %7.5

*P. mirabilis* %7.5

MRSA %6.5

GSBL %22.2

Malecki R et al. Adv Clin Exp Med 2014;23:39-48.

- 2010-2016, İsviçre

- 482 hasta 1018 DAI atağı

- *S. aureus* , *E. faecalis* ,  
*S. agalactiae* *P. aeruginosa*

Lebowitz et al. Int J of Infect Dis 2017; 59: 61-64

- Fransa; 271 izolat,

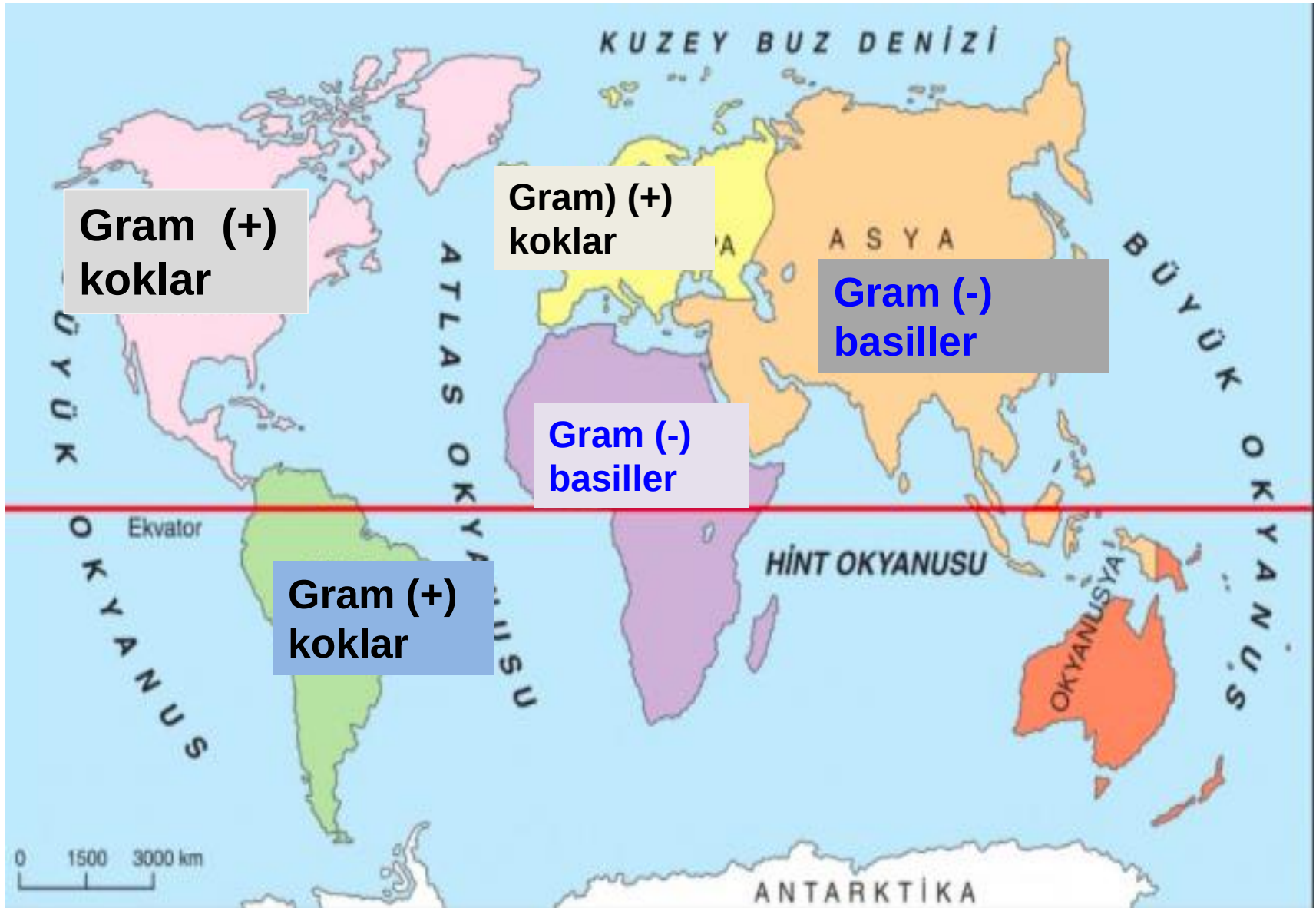
- %59 Gram(+) kok

*S. aureus* % 36.5 (99)

*P. aeruginosa* %9.6 (26)

*E. coli* %8.5 (23)

- Richard JLDiabetes & Metabolism 2008;34: 363-9.





# Ülkemiz verileri



# The microbiologic profile of diabetic foot infections in Turkey: a 20-year systematic review

## Diabetic foot infections in Turkey

- 1989-2011, 31 çalışma 1989-2011 ile 2007-2011 karşılaştırılmış.
- 2097 hasta, 1974 izolat

**Table 2** Pooled rates of microorganisms assessed between 1989 and 2011 and between 2007 and 2011

| Microorganisms                             | 1989–2011 | 2007–2011 |
|--------------------------------------------|-----------|-----------|
| Aerobic gram-positives                     |           |           |
| <i>Staphylococcus aureus</i>               | 23.8      | 19.1      |
| MRSA                                       | 7.8       | 5.7       |
| <i>Enterococcus</i> spp.                   | 8.6       | 10.4      |
| <i>Staphylococcus</i> (coagulase negative) | 8.9       | 10.0      |
| <i>Streptococcus</i> spp.                  | 6.5       | 7.3       |
| Other gram-positives                       | 1.0       | 2.0       |
| Total gram-positives                       | 48.7      | 48.8      |
| <i>Escherichia coli</i>                    | 12.5      | 12.0      |
| <i>Klebsiella</i> spp.                     | 6.5       | 7.0       |
| <i>Proteus</i> spp.                        | 5.3       | 5.0       |
| <i>Enterobacter</i> spp.                   | 4.0       | 4.5       |
| <i>P. aeruginosa</i> .                     | 13.7      | 14.9      |
| <i>Acinetobacter</i> spp.                  | 1.9       | 1.8       |
| Other Gram-negatives                       | 4.6       | 4.8       |
| Total gram-negative                        | 48.4      | 49.9      |
| Obligate anaerobes                         | 2.3       | 0.9       |
| Fungus                                     | 0.5       | 0.4       |

Her iki dönemde Gr(+)ve Gr(-)

bakteriler benzer oranda

*S. aureus* en sık (%23.8-19.1)

*P. aeruginosa* (%13.7-14.9)

Direnç:

MRSA %7.8-5.7

VRE %10.8

Karbapenem direnç

*P. aeruginosa* % 1.7

*A. baumannii* % 9.1



# Causative pathogens and antibiotic resistance in diabetic foot infections: A prospective multi-center study



35 merkez, prospektif

447 hasta, 522 izolat

%36.4 Gram (+) bakteri

*S. aureus* %11.4

(MRSA %1.8)

%60.2 Gram (-) bakteri

*E. coli* %15

*P. aeruginosa* %12.4

*Proteus spp* %9.6

**Table 2**

Frequency of isolation of microorganisms from wounds of patients with a diabetic foot infection.

| Bacteria                                         | PEDIS<br>Grade 2<br>% (N) | PEDIS<br>Grade 3<br>% (N) | PEDIS<br>Grade 4<br>% (N) | TOTAL<br>% (N) |
|--------------------------------------------------|---------------------------|---------------------------|---------------------------|----------------|
| Gram-positives                                   | 31.03 (18)                | 38.22 (99)                | 34.29 (24)                | 36.43 (141)    |
| <i>Staphylococcus aureus</i> (total)             | 13.79 (8)                 | 12.36 (32)                | 5.71 (4)                  | 11.37 (44)     |
| -Methicillin-sensitive                           | 13.79 (8)                 | 10.42 (27)                | 2.86 (2)                  | 9.56 (37)      |
| -Methicillin-resistant                           | 0                         | 1.93 (5)                  | 2.86 (2)                  | 1.81 (7)       |
| <i>Enterococcus</i> spp.                         | 6.90 (4)                  | 10.81 (28)                | 10 (7)                    | 10.08 (39)     |
| <i>Streptococcus</i> spp.                        | 5.17 (3)                  | 7.72 (20)                 | 7.14 (5)                  | 7.24 (28)      |
| Coagulase-negative<br><i>Staphylococcus</i> spp. | 5.17 (3)                  | 5.79 (15)                 | 10 (7)                    | 6.46 (25)      |
| Other gram-positives                             | 0                         | 1.54 (4)                  | 1.43 (1)                  | 1.29 (5)       |
| Gram-negatives                                   | 63.79 (37)                | 59.46 (154)               | 60 (42)                   | 60.21 (233)    |
| <i>Escherichia coli</i>                          | 12.07 (7)                 | 15.83 (41)                | 14.29 (10)                | 14.99 (58)     |
| <i>Pseudomonas aeruginosa</i>                    | 12.07 (7)                 | 13.90 (36)                | 7.14 (5)                  | 12.40 (48)     |
| <i>Proteus</i> spp.                              | 13.79 (8)                 | 9.27 (24)                 | 7.14 (5)                  | 9.56 (37)      |
| <i>Morganella morganii</i>                       | 5.17 (3)                  | 4.63 (12)                 | 5.71 (4)                  | 4.91 (19)      |
| <i>Enterobacter</i> spp.                         | 5.17 (3)                  | 4.25 (11)                 | 4.29 (3)                  | 4.39 (17)      |
| <i>Klebsiella</i> spp.                           | 1.72 (1)                  | 3.47 (9)                  | 4.29 (3)                  | 3.36 (13)      |
| <i>Acinetobacter</i> spp.                        | 5.17 (3)                  | 2.32 (6)                  | 2.86 (2)                  | 2.84 (11)      |
| <i>Serratia</i> spp.                             | 1.72 (1)                  | 1.16 (3)                  | 2.86 (2)                  | 1.55 (6)       |
| <i>Citrobacter</i> spp.                          | 0                         | 1.16 (3)                  | 4.29 (3)                  | 1.55 (6)       |
| Other gram-negatives                             | 6.90 (4)                  | 3.47 (9)                  | 7.14 (5)                  | 4.65 (18)      |
| Other organisms                                  |                           |                           |                           |                |
| <i>Candida</i> spp.                              | 1.72 (1)                  | 1.54 (4)                  | 2.86 (2)                  | 1.81 (7)       |
| <i>Candida albicans</i>                          | 3.45 (2)                  | 0.77 (2)                  | 0                         | 1.03 (4)       |
| <i>Finagoldia magna</i>                          | 0                         | 0                         | 1.43 (1)                  | 0.26 (1)       |
| <i>Hafnia</i> spp.                               | 0                         | 0                         | 1.43 (1)                  | 0.26 (1)       |
| Total                                            | 100 (58)                  | 100 (259)                 | 100 (70)                  | 100 (387)      |

# Antibiyotik duyarlılık

- **Gram (-) bakteriler:**

İmipenem -meropenem      %90.3 - 90.6

Amikasin                      %86.4

Piperasilin /tazobaktam    %83.4

Sefaperazon/sulbaktam    %83.3

Siprofloksasin                %62

- **Gram (+) bakteri:**

Teikoplanin %98.8, vankomisin %99.1, linezolid %95.7

# A prospective, multi-center study: factors related to the management of diabetic foot infections

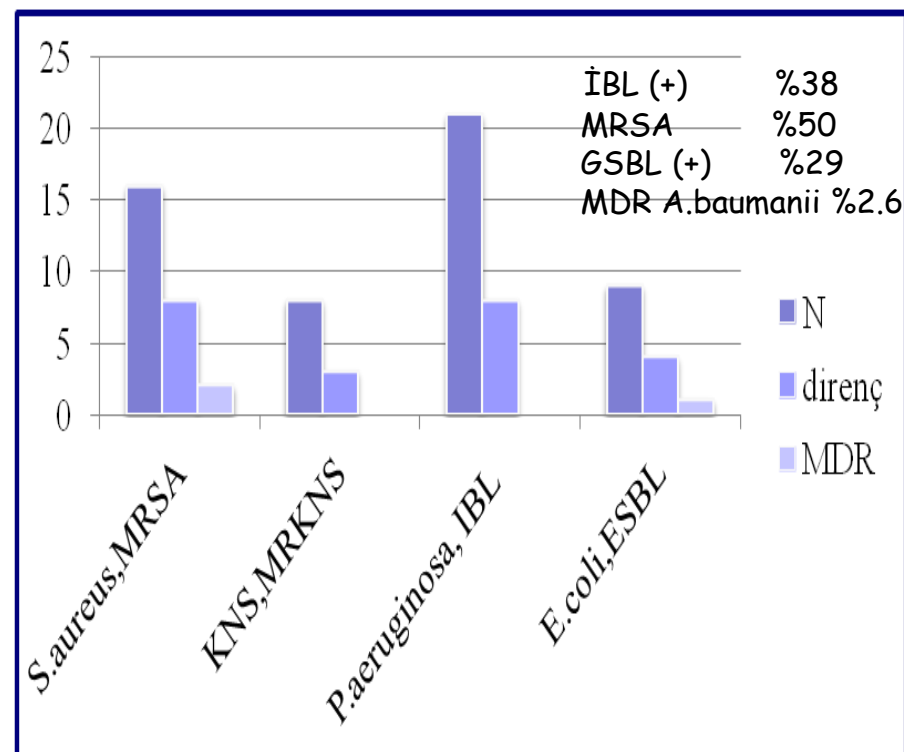
2010-2011

Gr (+) ve (-) aerob bakteri % 47.8

*P. aeruginosa* %18.4 (21)

*Streptococcus spp* %14.8 (17)

*S. aureus* %13.9 (16)



## Risk Factors for Infection with *Pseudomonas aeruginosa* in Diabetic Foot Infections

Ocak 2012 - Aralık 2013  
 25 merkez, retrospektif  
 71 hastada 89 bakteri  
 Gram (-) 49 (% 55.1)  
*P. aeruginosa* % 25.8 (23)  
*S. aureus* % 13.5 (12)  
 MRSA 4 (% 4.5)

Table 2. Microorganisms Isolated from Foot Wound Culture

| Causative Bacteria                  | No. (%)   |
|-------------------------------------|-----------|
| Gram-positive aerobic cocci         |           |
| <i>Staphylococcus aureus</i>        | 12        |
| Methicillin resistant               | 4         |
| Coagulase-negative staphylococcus   | 10        |
| Methicillin resistant               | 6         |
| <i>Streptococcus</i> spp            | 8         |
| <i>Enterococcus</i> spp             | 6         |
| Subtotal                            | 36 (40.4) |
| Gram-negative aerobic bacilli       |           |
| <i>Pseudomonas aeruginosa</i>       | 23        |
| <i>Escherichia coli</i>             | 7         |
| <i>Klebsiella pneumoniae</i>        | 6         |
| <i>Proteus</i> spp                  | 5         |
| <i>Morganella morganii</i>          | 4         |
| <i>Enterobacter</i> spp             | 2         |
| <i>Serratia marcescens</i>          | 1         |
| <i>Stenotrophomonas maltophilia</i> | 1         |
| Subtotal                            | 49 (55.1) |
| Obligate anaerobes                  | 3 (3.4)   |
| <i>Candida parapsilosis</i>         | 1 (1.1)   |
| Total                               | 89 (100)  |

## Predictors for limb loss among patient with diabetic foot infections: an observational retrospective multicentric study in Turkey

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- 17 merkez, Mayıs 2011-Mayıs 2013

- 455 hasta, 208 mikroorganizma

Gram (-) bakteriler % 54.8

Gram( +) bakteriler % 44.2

- MSSA %17.8 (37)

- *P.aeruginosa* % 17.3 (36)

- *E.coli* % 14.4 (30)

- *Enterobacter spp* %5.3 (11)

- MRSA % 5.3 (11)

- MRKNS % 8.6 (18)

- *Streptokok spp* % 6.7 (14 )

- *Enterokok spp* % 5.8 (12 )

- ESBL enterobacteriaceae  
%19.6



## Influence of multidrug resistant organisms on the outcome of diabetic foot infection

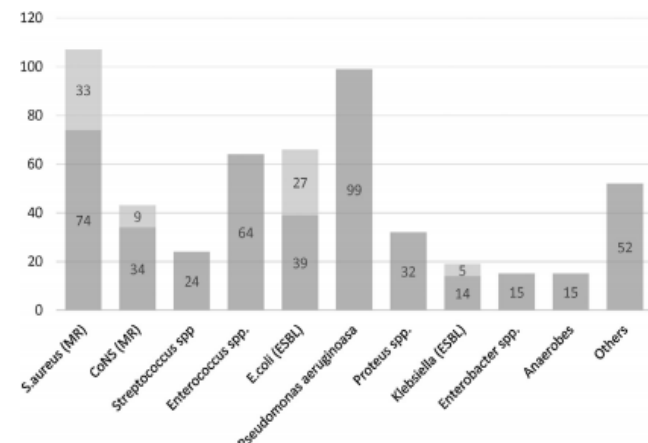


- Mayıs 2011-Aralık 2015
- 19 merkez, 791 hasta, 536 mikroorganizma
- 301 (% 56.1) Gram (-)
- **MRSA %6.1**
- **MDR *P.aeruginosa* %21**
- **GSBL Gr(-) bakteri 32 (%38)**
- (E. coli /klebsiella 27/5)

***S. aureus* % 20 (107)**

***P. aeruginosa* % 19 (99)**

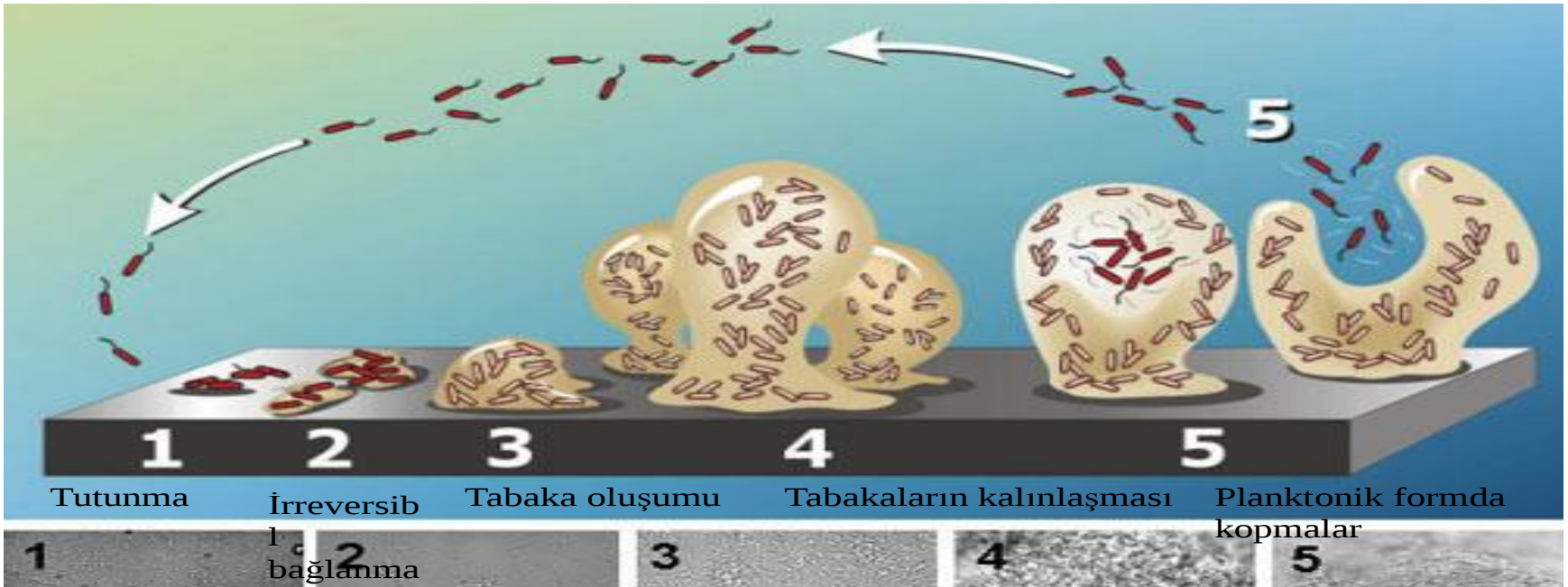
***E. coli* %12 (65)**



| Çalışmacı<br>Yayın yılı                 | İzolat<br>N | Gram<br>(+) % | Gram<br>(-) % | İlk 2 etken<br>(%)                                                      | Direnç (%)<br>(MRSA,<br>GSBL, IBL)                          |
|-----------------------------------------|-------------|---------------|---------------|-------------------------------------------------------------------------|-------------------------------------------------------------|
| Kandemir et al<br>2007                  | 104         | 43.3          | 54.8          | <i>S. aureus</i> (29.8)<br><i>E .coli</i> (20.1)                        | MDR (35.2)                                                  |
| <i>Ertuğrul et al.</i><br>2012          | 115         | 47.8          | 47.8          | <i>P.aeruginosa</i> (18.4)<br><i>Streptokok spp</i> (14.8)              | MRSA (50)<br>GSBL (29)<br>IBL (38)                          |
| <i>Ertuğrul et al.</i><br>2017          | 89          | 55.1          | 44.9          | <i>P. aeruginosa</i> ( 25.8)<br><i>S aureus</i> (13.5)                  |                                                             |
| <i>Turhan et al.</i><br>2013            | 312         | 38.7          | 61.3          | <i>P.aeruginosa</i> (34.8)<br><i>Staphylococcus spp</i> (19.5)          | MRSA (44.2)<br>VRE (3)<br>IBL (17.6-32.2)                   |
| <i>Hatipoğlu et al</i><br>2014( 20 yıl) | 1974        | 48.7          | 48.4          | <i>S. aureus</i> (23.8)<br><i>P .aeruginosa</i> (13.7)                  |                                                             |
| <i>Hatipoğlu et al.</i> 2016            | 522         | 36.4          | 60.2          | <i>E. coli</i> (15)<br><i>P. aeruginosa</i> (12.4)                      | MRSA (1.8)                                                  |
| <i>Saltoğlu et al,</i><br>2015          | 208         | 44.2          | 54.8          | <i>S.aureus</i> (17.8)<br><i>P.aeruginosa</i> (17.3)                    | MRSA( 5.3)<br>GSBL (19.6)                                   |
| Saltoğlu N et<br>al.2018                | 536         | 43.9          | 56.1          | <i>S.aureus</i> (20)<br><i>P.aeruginosa</i> (19)<br><i>E.coli.</i> (12) | MRSA ( 6.1)<br>MDR <i>P.aeruginosa</i><br>(21)<br>GSBL (38) |

# DAİ biofilm

- Biofilm: Yüzeyle tutunarak ekstra sellüler matriks içinde birlikte yaşayan mikroorganizma topluluğu
- %90dan fazlası su, kalanı mikroorganizmalar, proteinlerden oluşur.





- Biyofilm infeksiyonlarında tanı zor
- Antibiyotiklerin biofilme içine geçişi sorunlu,
- Biofilm içindeki bakterileri konak savunma mekanizmaları ile temizlenmesi zor
- Antibiyotik dirençli infeksiyonlar daha sık.

# Polymicrobial Nature of Chronic Diabetic Foot Ulcer Biofilm Infections Determined Using Bacterial Tag Encoded FLX Amplicon Pyrosequencing (bTEFAP)

**Table 1.** Bacterial genera identified in 40 diabetic foot ulcers.

| Genera                         | Samples | Avg % | Std dev | Min-max % |
|--------------------------------|---------|-------|---------|-----------|
| <i>Corynebacterium</i> spp.    | 30      | 14.4  | 27.5    | 0.22–80.6 |
| <i>Bacteroides</i> spp.        | 25      | 24.2  | 34.8    | 0.15–98.8 |
| <i>Peptoniphilus</i> spp.      | 25      | 13.6  | 9.9     | 0.22–38.4 |
| <i>Finegoldia</i> spp.         | 23      | 6.7   | 4.1     | 0.65–20.5 |
| <i>Anaerococcus</i> spp.       | 22      | 7.7   | 6.1     | 1.28–23.8 |
| <i>Streptococcus</i> spp.      | 21      | 36.5  | 26.2    | 1.68–88.8 |
| <i>Serratia</i> spp.           | 17      | 21.4  | 22.9    | 0.82–98.4 |
| Unknown-b                      | 15      | 16.8  | 13.2    | 0.93–62.2 |
| <i>Staphylococcus</i> spp.     | 13      | 8.3   | 10.0    | 0.65–32.6 |
| <i>Prevotella</i> spp.         | 12      | 7.4   | 24.9    | 0.87–37.3 |
| <i>Peptostreptococcus</i> spp. | 11      | 8.7   | 4.5     | 0.85–41.5 |
| <i>Porphyromonas</i> spp.      | 10      | 7.0   | 3.6     | 2.38–24.3 |
| <i>Enterococcus</i> spp.       | 10      | 2.8   | 1.2     | 0.31–8.4  |
| <i>Actinomyces</i> spp.        | 9       | 5.7   | 5.6     | 1.81–20.2 |
| <i>Pseudomonas</i> spp.        | 8       | 14.5  | 11.6    | 0.67–94.3 |
| <i>Clostridium</i> spp.        | 8       | 2.3   | 3.2     | 0.75–5.9  |
| <i>Helcococcus</i> spp.        | 5       | 2.5   | 3.0     | 0.91–7.3  |
| <i>Brevibacterium</i> spp.     | 5       | 1.8   | 0.7     | 0.71–2.46 |
| <i>Varibaculum</i> spp.        | 4       | 9.0   | 10.5    | 1.46–27.8 |
| <i>Aerococcus</i> spp.         | 4       | 3.0   | 3.6     | 0.47–7.0  |
| <i>Fusobacterium</i> spp.      | 3       | 5.6   | 2.6     | 1.99–7.9  |
| <i>Arthrobacter</i> spp.       | 3       | 3.8   | 2.5     | 1.85–7.4  |
| <i>Bacillus</i> spp.           | 3       | 3.5   | 3.0     | 0.19–7.5  |
| <i>Anaerobiospirillum</i> spp. | 3       | 2.3   | 1.1     | 0.37–3.8  |
| <i>Actinobaculum</i> spp.      | 3       | 1.9   | 1.0     | 0.53–2.9  |
| <i>Dermabacter</i> spp.        | 3       | 1.6   | 0.9     | 0.78–2.87 |
| <i>Salmonella</i> spp.         | 3       | 1.5   | 1.1     | 0.52–3.02 |
| <i>Veillonella</i> spp.        | 3       | 1.3   | 4.5     | 1.12–1.49 |
| <i>Citrobacter</i> spp.        | 2       | 9.5   | 2.5     | 7.0–12.0  |
| <i>Rothia</i> spp.             | 2       | 5.8   | 3.2     | 1.27–10.2 |
| <i>Tissierella</i> spp.        | 2       | 4.0   | 2.7     | 1.34–6.6  |
| <i>Propionibacterium</i> spp.  | 2       | 3.3   | 0.4     | 2.82–3.7  |
| <i>Proteus</i> spp.            | 2       | 3.1   | 2.2     | 0.89–5.3  |
| <i>Aerosphaera</i> spp.        | 2       | 2.8   | 1.9     | 1.11–4.5  |
| <i>Peptococcus</i> spp.        | 2       | 2.5   | 0.8     | 1.64–3.3  |
| <i>Dermabacter</i> spp.        | 2       | 1.2   | 0.7     | 0.61–1.85 |
| <i>Granulicatella</i> spp.     | 2       | 1.2   | 0.3     | 0.86–1.51 |
| <i>Brevundimonas</i> spp.      | 2       | 0.9   | 0.2     | 0.63–1.07 |

|                            |          |
|----------------------------|----------|
|                            | <i>n</i> |
| <i>Corynebacterium</i> spp | 30       |
| <i>Bacteroides</i> spp     | 25       |
| <i>Peptoniphilus</i> spp   | 25       |
| <i>Finegoldia</i> spp      | 25       |
| <i>Aerococcus</i> spp      | 22       |
| <i>Streptococcus</i> spp   | 21       |
| <i>Serratia</i> spp        | 17       |
| <i>Staphylococcus</i> spp  | 13       |

# Biofilm çalışmaları

100 izolat,  
38 inde (%46.3) biofilm  
80 izolat MDR,  
(%46.3 biofilm)

Biofilm pozitifliği  
*S. aureus* %38.8  
(MRSA ların tümü)

*P. aeruginosa* %26.5

*Citrobacter* spp %10.5

Banu A et al. AMJ 2015;8(9):280-285]

2008-11, 162 hasta, prospektif  
Gram(-)/(+) %65.4/34.5  
En sık; *E. coli*, *S. aureus*,  
*P. aeruginosa*

255 izolat, 179 (%70) biofilm

Gram (+) biofilm % 68.1

*S. aureus* %48.8

Gram (-) biofilm % 71.2

*E.coli* % 32.3

*P. aeruginosa* % 19.7

# Ülkemizde DAI biofilm

- 2008-2015, 165 DAI
- 339 bakteri
- 115'inde (% 34) biofilm

- Etkenler

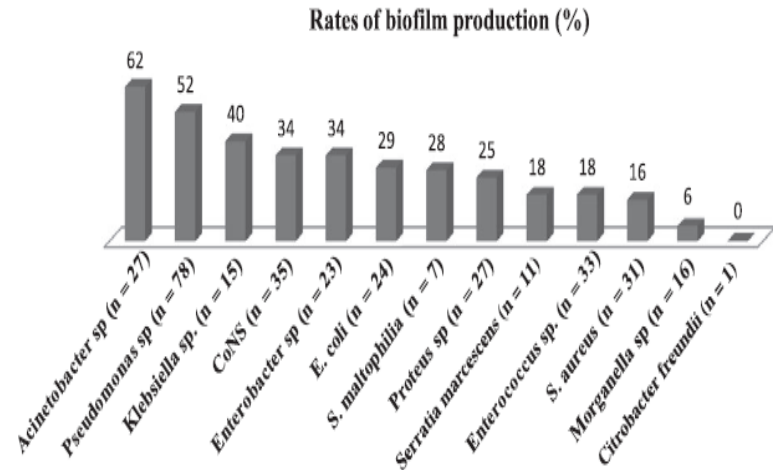
*P. aeruginosa* 78 (%52)

KNS 35 (%34)

Enterokok spp 33 (%28.7)

*Proteus spp* 27 (%25)

- Biofilm pozitif olanlar
- *A. baumannii* % 62
- *Pseudomonas spp* % 52
- *Klebsiella spp* % 40



# Ülkemizde DAI biofilm

- 2013-2015, 55 hasta
- 81 izolat **67 (%82.7)** biofilm oluşumu
- Etkenler
  - P. aeruginosa* 16 (%19.8)
  - KNS 15 (%18.5)
  - E. coli* 14 (%17.3)

Tablo 1. Diyabetik ayak enfeksiyonlarında izole edilen türler ve biyofilm oluşturma oranları.

| Mikroorganizma               | n (%)*    | Biyofilm n (%)** |
|------------------------------|-----------|------------------|
| Gram-pozitif kok             | 28 (34.5) | 23 (82.1)        |
| Koagülaz negatif stafilokok  | 15 (18.5) | 13 (86.6)        |
| <i>Staphylococcus aureus</i> | 8 (9.9)   | 6 (75)           |
| <i>Enterococcus</i> spp.     | 4 (4.9)   | 3 (75)           |
| Grup D streptokok            | 1 (1.2)   | 1 (100)          |
| Gram-negatif çomak           | 53 (65.5) | 44 (83.0)        |
| <i>Pseudomonas</i> spp.      | 16 (19.8) | 15 (93.7)        |
| <i>Escherichia coli</i>      | 14 (17.3) | 9 (64.2)         |
| <i>Acinetobacter</i> spp.    | 10 (12.3) | 8 (80)           |
| <i>Klebsiella</i> spp.       | 5 (6.2)   | 4 (80)           |
| <i>Proteus</i> spp.          | 4 (4.9)   | 4 (100)          |
| <i>Enterobacter</i> spp.     | 2 (2.5)   | 2 (100)          |
| <i>Serratia</i> spp.         | 2 (2.5)   | 2 (100)          |
| Toplam                       | 81*       | 67 (82.7)**      |

# Sonuç olarak

- ABD, Avrupa ülkelerinde *S. aureus* en sık olmak üzere Gr (+)l
- Asya ülkelerinde *P. aeruginosa* ve diğer Gram (-) basiller sık
- Ülkemizde bazı çalışmalarda *S. aureus*, bazı çalışmalarda *P. aeruginosa* en sık etken
- PCR gibi moleküler tanı testleri ile zor üreyen ve zorunlu anaerob bakteriler daha fazla tanımlanmakta
- Özellikle Gram (-) bakterilerde direnç artmakta
- Biofilm ve biofilm pozitif bakteriler ve antibiyotik direnci önemli bir sorun

***Teşekkürler***