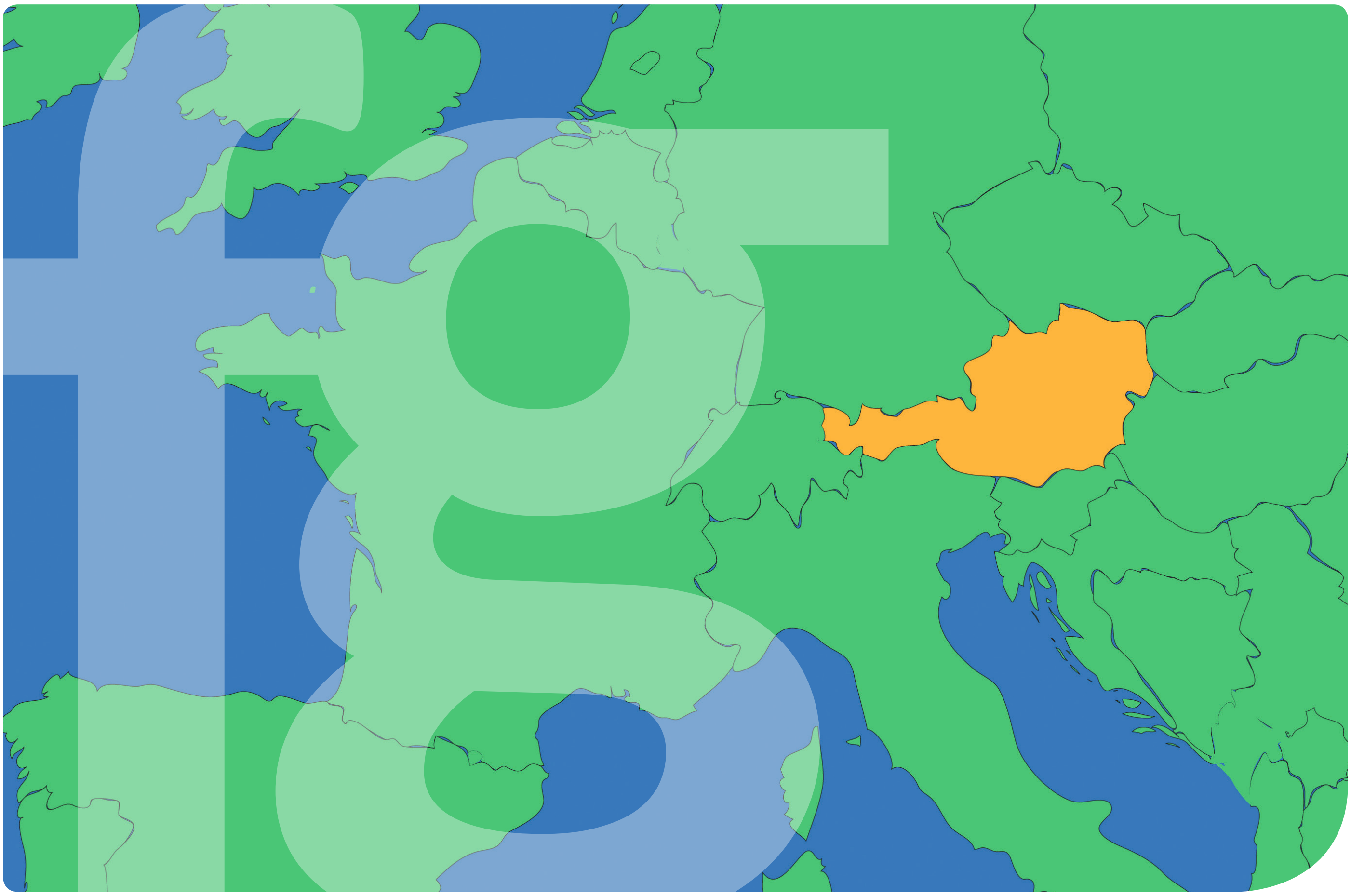
Ordens klinikum Linz
Barmherzige Schwestern Elisabethinen

AGES

MINISTERIUM FRAUEN GESUNDHEIT

Resistance Report Austria AURES 2016

Summary



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Introductory Remarks

The AURES – the report on antimicrobial resistance in Austria – has been published by the Federal Ministry of Health and Women's Affairs on an annual basis, thereby providing for the observation of the development of the resistance situation in Austria and, hence, deducing strategic measures and decisions therefrom. The rational and selected use of antimicrobially effective drugs represents an important prerequisite for a successful therapy of infections also in the future.

With the summary of the AURES, there is to be enabled a simple form of access to information regarding antibiotic resistance. In this way, the significance of antimicrobial resistance for the treatment of humans and animals having acquired a disease may be explained to a broader public. Furthermore, the awareness of the importance of the proper handling of antimicrobial substances may be increased in this way.

Yours,

Pamela Rendi-Wagner, MD, MSc
Federal Minister of Health and Women's Affairs

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LIST OF ABBREVIATIONS

Table 1: List of abbreviations

Abbreviation	Long text
AGES	Austrian Agency for Health and Foodsafety
AMR	Antimicrobial resistance
ART	Antiretroviral therapy
AT	Austria
AURES	Austrian Report on Antimicrobial Resistance
BIOHAZ	Biological Hazards
BMGF	Federal Ministry of Health and Women´s Affairs
CASCADE	Co-operative Air Traffic Services Through Surveillance and Communications Applications Deployed in ECAC
CLSI	Clinical and Laboratory Standards Institute
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECAC	European Civil Aviation Conference
EFSA	European Food Safety Authority
ESAC-Net	European Surveillance of Antibiotic Consumption Network
ESBL	Extended spectrum beta-lactamase
ESVAC	European Surveillance of Veterinary Antimicrobial Consumption
EU	Europe/European
EUCAST	European Committee on Antimicrobial Susceptibility Testing
HIV	Human immunodeficiency virus
MDR	Multidrugresistance
MIC	Minimum inhibitory concentration
MRSA	Methicillin-resistant Staphylococcus aureus
MSSA	Methicillin-sensitive Staphylococcus aureus
NNRTI	Non-nucleoside reverse transcriptase inhibitors
NRTI	Nucleoside reverse transcriptase inhibitors
OIE	World Organization for Animal Health
STD	Sexual transmitted diseases
TB	Tuberculosis
TDR-Tuberkulose	Transmitted drug-resistant tuberculosis
VRE	Vancomycin-resistant enterococci
WHA	World Health Assambly
WHO	World Health Organization
XDR-Tuberkulose	Extensively drug-resistant tuberculosis

INTRODUCTION

The present summary of the AURES 2016 has resulted from the full version of the AURES 2016, an inter-departmental co-operation in the field of human and veterinary medicine as well as food technology. Like in the reports of the previous years, the aim of the AURES 2016 is the sustainable and comparative illustration of representative data on antimicrobial resistance and on the consumption of antimicrobial agents with special consideration of Austrian characteristics and development trends over time. The data provided by National Reference Centres, appointed by the Federal Ministry of Health and Women's Affairs, and the respective projects are illustrated in separate chapters. This method has been chosen in order to take into account the different approaches used in data collection. Direct comparison with data from veterinary medicine and human medicine is only possible to a limited extent at the present on account of the use of different test procedures and/or laboratory methods and antimicrobial limit values (epidemiological cut-offs and clinical limit values). The AURES provides data for a comprehensive professional discussion and will subsequently contribute to the optimization of the use of antimicrobial agents in Austria. The present short version is composed of the summaries of the individual chapters of the AURES. In this way, a first introduction to the subject of antimicrobial resistance and a brief survey on the situation in Austria will be made available. Details on the individual chapters may be found in the long version of the AURES 2016.

INITIAL SITUATION

Antibiotics have been used for decades for the treatment and prevention of infectious diseases and infections. The use of antimicrobial agents has highly contributed to the improvement of the state of health of human beings and animals. Antibiotics are indispensable in modern medicine and procedures; transplantations, chemotherapies to treat cancer or orthopaedic surgery, all these could not be performed without antibiotics. A steady increase of resistant microorganisms, however, has been associated with the wide application thereof. The Health Ministers of the European Union in the year 2012 issued a declaration, emphasizing that this increasing antibiotic resistance in Europe and all over the world constitutes a growing health hazard for human beings and animals, leading to limited or inadequate treatment options and, hence, diminishing the quality of life [1]. The World Health Organization (WHO) had chosen as the primary issue in 2011 for the World Health Day on April 7 the theme of "*Antimicrobial resistance: no action today, no cure tomorrow*" [2]. Since 2008, on the initiative of the European Parliament, the European Antibiotic Awareness Day has been held annually on November 18, with the objective to inform the population as well as those skilled in the art on the prudent use of antimicrobially active agents. Furthermore, the problem of antimicrobial resistance was included in the working programme of the European Commission in 2015 as a "key priority" (being of highest importance and priority) [3]. The topic of antibiotic resistance was part of the agenda of the G7 Summit in 2015 in Schloss Elmau, Germany. The global action plan of the WHO is to be supported and promoted. The G7 member nations aim at following the approach of "One Health" [4].

In human medicine, the use of antibacterial agents for the treatment of viral infections, the unjustified use of agents having an extremely wide action spectrum, too long "prophylactic" use of antibiotics with surgical interventions and the use of antibiotics in the case of mere colonization (and not infection) of the patient are considered the essential reasons and causes of the resistance problem. Furthermore, patients (in the case of children, their parents) with therapy demands contribute to the improper use of antibiotics. The causal relationship between antibiotic use and development of resistance in bacteria may clearly be demonstrated for both infections in patients of medical practitioners as well as nosocomial infections [5]. Already in the Council Recommendation of November 15, 2001 for the prudent use of antimicrobial agents in human medicine, the member states were asked to ensure that specific strategies for the prudent use of antimicrobial agents are available and are implemented with the object to limit the increase of microorganisms being resistant to these agents [6].

Attempts to reduce the development of resistance through a rational use of antibiotics by general practitioners have been found on a European level [7]. These efforts are mainly directed at the omission of antibiotic use in the treatment of viral infections. The fact that high-quality microbiological diagnostics is not available throughout Austria makes it in many cases difficult for the physician to clearly differentiate between infections requiring treatment and such that do not require antimicrobial therapies; in addition, it is frequently only possible to start with a very broad antimicrobial therapy. This will result in unnecessary use of antibiotics and the preferred use of agents having a wide spectrum of action – both being factors that promote the development of antibiotic resistance due to an immanent selection pressure. Due to the improved treatability of viral diseases, also drug-resistant viruses are gaining increasing importance. The biggest hazard caused by drug-resistant viruses is currently posed by HIV infection. This may lead to a limited or absent effectiveness of the anti-retroviral therapy with patients being already in treatment as well as with persons infected with these resistant viruses.

In hospitals, and especially in the intensive care units, multi-resistant hospital pathogens have been considered a problem of everyday life. The combination of "immunocompromised" patients, the intensive and prolonged use of antibiotics as well as the transmission of pathogens between patients will lead to the occurrence of infections with multi-resistant pathogens, which sometimes will not be responsive to antibiotic therapy anymore. In the document "WHO Global Strategy for Containment of Antimicrobial Resistance", the World Health Organization refers to hospitals as "*a critical component of the antimicrobial resistance problem worldwide*" [8].

Although it is still true that "*most of the problems with resistance in human medicine are correlated to use of antimicrobials in humans*", it is currently in no way doubted that, in the field of foodstuff having animal origin, the antibiotic resistance is also of significance [9, 10]. The Panel on Biological Hazards (BIOHAZ) of the European Food Safety Authority (EFSA) already in the year 2008 recommended the elaboration and implementation of specific measures for the control of raw poultry, pork and beef, wherein measures for countering antibiotic resistance were classified as a priority [11]. In the veterinary field, in Austria already since 2004 compulsory surveillance of the prevalence of zoonoses and selected zoonotic pathogens as well as their susceptibility to antimicrobial agents in the livestock population of Austria has been carried out (in the form of randomized sampling schemes in healthy slaughtered animals – cattle, pork, poultry) [12]. The OIE (World Organization for Animal Health) has elaborated recommendations for countering antimicrobial resistance in order to protect the health of animals and ensure food safety [13]. In regard to the surveillance of the antibiotic resistance and the ascertainment of antibiotics volume flows there have been existent guidelines for the harmonization of national programmes as well as recommendations on the prudent use of antibiotics in veterinary medicine and on the risk assessment of antibiotic resistance with the treatment of animals as well as for laboratory methods for the detection of antibiotic resistance.

The increasing antibiotic resistance of human pathogens currently constitutes a problem, which requires the willingness of all fields and sectors involved (human medicine, veterinary medicine, primary livestock production, food processing and food preparation, consumers) to assume responsibility in their respective areas of influence in order to impede the development and further distribution of antimicrobial resistance. The World Health Assembly (WHA) as the supreme decision-making organ of the World Health Organization (WHO) on May 25, 2015, passed a resolution asking all WHO member states to develop concrete national action plans for countering the problem of antimicrobial resistance within two years (until 2017), with the aspect of "ensuring sustainable investment in countering AMR" being one of the five objectives determined [14].

The issue antibiotic resistance was discussed on occacion of the G7 Summit in Schloss Elmau (7th to 8th June 2015) [15].

In the year 2016 the conclusions of the Council regarding the next steps within the concept of "One Health" for combatting antimicrobial resistance were published [16]. On September 21, 2016, the problem of antimicrobial resistances was addressed on the level of the General Assembly of the United Nations [17]. As a result a political declaration was published ("Political declaration of the high-level meeting of the General Assembly on antimicrobial resistance") [18]. The European Commission published a new action plan against antimicrobial resistance in 2017 [19].

Co-ordinated measures for countering the distribution of antimicrobial resistance are in need of surveillance systems. Only with these, it will be possible to assess how local and global resistance situations will react to an altered use of antibiotics and new measures for infection control. In the field of human medicine, many Austrian hospitals participate in the European system for the surveillance of resistance to antimicrobial agents ("European Antimicrobial Resistance Surveillance

Network" [EARS-Net]) and in the "European Surveillance of Antibiotic Consumption Network" (ESAC-Net). EARS-Net and ESAC-Net are surveillance programmes initiated by the Community and confirmed in their importance by the EU Council, wherein standardized, harmonized and comparative human medicine data on the resistance to bacterial pathogens and/or the use of antibiotics are being sampled and collected [1]. The present Resistance Report makes available to the public the data acquired within the network of the Austria-wide resistance surveillance.

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Antimicrobial resistance in selected bacterial invasive infectious pathogens

Data from the human sector

An activity by the National Reference Centre for nosocomial infections and antibiotic resistance within the scope of participation in the European Antimicrobial Resistance Surveillance Network (EARS-Net)

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European Antimicrobial Resistance Surveillance Network (EARS-Net)

The Austrian EARS-Net data represent a data base of currently 134 acute care hospitals. The resistance rates of the invasive indicator pathogens, hence, constitute a reliably measured substitute value for the prevalence of the resistance of the respective pathogens in relation to the antibiotic substances selected. In 2011, as far as human-medicine antimicrobial susceptibility testing methodology is concerned, Austrian microbiology laboratories switched from CLSI to EUCAST, a process that was successfully completed in 2012. The Austrian results for 2016 may be summarised as follows:

In the case of ***S. pneumoniae***, there has been existent a stable and very positive situation for penicillin for years. According to EUCAST threshold values that differ due to clinical indication and intended forms of administration, isolates having a MHK of > 2 mg/l would be regarded as "highly resistant". In 2016 not one of such isolates was detected in Austria. Based on the strict Meningitis threshold values, only 5 invasive isolates proved to be resistant to penicillin in the year 2016 (1.1%). The situation of the resistance rate in regard to macrolides in comparison to 2015 remained more or less unchanged (8.7% to 8.8%), while being reduced by half over a comparative period of five years (17.7% in the year 2012). The three most frequent serotypes of invasive isolates in the year 2016 were 3, 19A and 22F. With children younger ≤ 2 years, type 19A was the most frequent one. In the age group of 60+, the most frequent serotypes were 3, 19A und 22F.

The **MRSA rate** has shown a downward trend since 2013, being as low as 7.1% in 2016. No reduced sensitivity to (resistance against) vancomycin was detected and confirmed in the year 2016 in any invasive *S. aureus* isolate.

In the case of ***E. coli***, the resistance rate in regard to aminopenicillins (50%) has remained essentially stable since 2010. In comparison to 2015, the resistance rate in regard to fluoroquinolones was slightly reduced (from 20.0% to 19.8%), while the resistance rates in regard to 3rd generation cephalosporins (from 9.7% to 10%) and aminoglycosides (from 7% to 7.8%), respectively, have increased.

With ***enterococci***, essentially no change of the resistance rates in regard to aminopenicillin and aminoglycosides has been detected in comparison to the years before. The **VRE** rate was 0.3% with *E. faecalis* and 4.3% with *E. faecium*.

In the case of ***K. pneumoniae***, the resistance rates in regard to fluoroquinolones and 3rd generation cephalosporins showed a notably declining trend up to 2014, with that for aminoglycosides remaining essentially stable. In comparison to 2015, the resistance rates with 3rd generation cephalosporins have increased (from 8.4% to 9.6%), while those with fluoroquinolones have decreased (from 11.7% to 9.8%). The resistance rate in regard to aminoglycosides remained stable at 4.8%.

Carbapenemase producing isolates: In 2016 one invasive *E. coli* isolate strain and 11 invasive strains of *K. pneumonia* were documented.

With ***P. aeruginosa***, a decrease of the resistance rates in connection with the following substance classes was recorded in 2016: fluoroquinolones 7.2% (-3.1%) and aminoglycosides 6.1% (-0.2%). The resistance rates in regard to carbapenems increased to 12.9% (+0.7%), those in regard to piperacillin/tazobactam to 13.8% (+1.9%) and those in regard to ceftazidime to 11.3% (+1.4%).

On the basis of only 81 isolates in total, ***Acinetobacter sp.*** showed resistance rates in regard to aminoglycosides of 16.1%, in regard to fluoroquinolones of 16.1% and in regard to carbapenems of 12.4%, respectively.

In total, there is still a positive situation detectable in Austria, especially with nosocomial gram-positive pathogens like MRSA and VRE. Compared to other European countries, the resistance rates are low. A rather problematic field, however, is still being represented by the gram-negative pathogens.

The full report can be found in the long version of the AURES 2016 from page 19 to page 92 (AURES 2016).

Project report CARBA-Net

Data from the human sector

An activity by the National Reference Centre for nosocomial infections and antibiotic resistance

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Increasing numbers of carbapenemase producing gram negative bacteria are reported worldwide [1]. As a consequence, the surveillance project CARBA-Net was initiated in April 2015. In 2016 in 102 out of 163 *Enterobacteriaceae* strains referred to the Austrian National Reference Laboratory due to decreased carbapenem susceptibility, a carbapenemase gene was confirmed. The enzymes could be assigned to Ambler classes A (*bla*KPC [n=14] and *bla*IMI [n=1]), B (*bla*VIM [n=40] and *bla*NDM [n=15]) and D (*bla*OXA-48 like [n=32]). With regard to other gramnegative bacilli, 40 out of 99 suspected *Pseudomonas aeruginosa* isolates were positive for a metallo-beta-lactamase (*bla*VIM [n=35], *bla*DIM [n=2], *bla*IMP [n=2] and *bla*NDM [n=1]) and 18 *Acinetobacter baumannii* isolates gave a positive result for *bla*OXA-51 in combination with either *bla*OXA-23, *bla*OXA-24 or *bla*OXA-23 with *bla*NDM.

The full report can be found in the long version of the AURES 2016 from page 93 to page 100 (AURES 2016).

Resistance report for selected non-invasive pathogens

Data from the human sector

An activity of the working group resistance reporting

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The collected data of twelve centers/laboratories from all over Austria are highly reliable and represent the prevalence of antibiotic resistance of selected so called "non-invasive isolates" from 2012 to 2016. The aim of this annual survey is also to highlight the difference in resistance rates comparing "hospital derived isolates" with "community-derived isolates", gained from out-patient-clinics. We report resistance-rates for the following "indicator-organisms" for 2016:

1. ***Group A streptococci*** *(n=*2,602*)* from the lower and upper respiratory tract demonstrated lower resistance rates for macrolides compared to ***pneumococci*** (n=1,355) in both out- and in-patient settings (6.0% / 8.4% versus 13.8% / 13.8%). Pooled resistance rate for macrolides in *pneumococci* is above resistance of invasive *pneumococci* of EARS-net AT data: 13.8 % versus 8.8%. Resistance rates in *H. influenzae* (n=2,603) in hospitals and the community are as follows: aminopenicillins 27.3% and 25.5%; aminopen. + betalactamaseinhibitor 9.0% and 6.8%, fluoroquinolones 0.6% and 0.5% respectively.
2. **ESBL-producing *E. coli*** (n=2,985) from urine samples remain stable with 7.6% over the last two years and do not differ whether gained from samples in (8.2%) or outside (6.9%) the hospital. Fluoroquinolones proved to have high resistance rates in all *E. coli* isolates (16.2%, n=44,986) and very high in ESBL-producing *E. coli* (73.5%) and sulfamethoxazol/trimethoprim demonstrated similar results (23.3% vs 63.0%).
3. ***Klebsiella pneumoniae*** (n=9,511) from urine samples showed a resistance rate against 3rd generation cephalosporins of 7.7% and a carbapenem resistance of 0.7% in 2016.
4. ***Staphylococcus aureus*/MRSA**(n=23,030/1,330): hospital associated MRSA rate was 8.2%, in out-patients the MRSA rate was 4.8%. There were no isolates identified resistant to linezolid or vancomycin but 0.5% resistance against Dapatomycin in MSSA.
5. ***Pseudomonas aeruginosa***: Stable high resistance rates of all selected substances for isolates from lower respiratory tract (as a surrogate for isolates from the ICU; n=853): Carbapenems showed a rate of 17.2% and Ceftazidim 19.5%. Ear-derived isolates (as a surrogate for external otitis; n=1,349) showed a stable rate of 3.7% for aminoglycosides.

The full report can be found in the long version of the AURES 2016 from page 101 to page 119 (AURES 2016).

Resistance report *Neisseria meningitidis*

An activity of the National Reference Centre for Meningococci

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The National Reference Centre for Meningococci received 74 culturable isolates in 2016. Of these, 22 isolates were from invasive infections. Thirty-five of the 74 isolates were polyagglutinable (PA) (47.3 %), 25 serogroup B (33.8 %), 5 serogroup C (6.8 %), 5 serogroup Y (6.8 %) and 4 were serogroup W (5.4 %).

According to EUCAST (v. 6.0), 29 isolates showed reduced susceptibility to penicillin. Ten of the 29 intermediate strains were invasive isolates. Thirteen isolates, all non-invasive, were resistant to penicillin (MHK > 0.25 mg/L). One strain was resistant to rifampicin. All of the strains were in vitro susceptible to ciprofloxacin und ceftriaxone.

The full report can be found in the long version of the AURES 2016 from page 120 to page 126 (AURES 2016).

Resistance report *Campylobacter*

Data from the human and food sector

An activity of the National Reference Centre for *Campylobacter*/the National Reference Laboratory for *Campylobacter* from food and feed products

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In 2016, a total of 7,086 cases of campylobacteriosis were reported in Austria (data source: statistics for notifiable infectious diseases, final annual report 2016). A high to very high tetracycline and fluorochinolone resistance rate, respectively, were found in *C. jejuni* and *C. coli* isolates of human and food (chicken) origin. In contrast to previous years no further increase in fluorochinolone resistance in *Campylobacter* from human isolates was seen, fluorochinolone resistance was found to be 72.5% in *C. jejuni* and 81.4% in *C. coli*. Resistance towards erythromycin remained low and was primarily recorded in *C. coli*.

The full report can be found in the long version of the AURES 2016 from page 127 to page 138 (AURES 2016).

Resistance report *Salmonella*

Data from the human, food and veterinary sector

An activity of the National Reference Centre for *Salmonella*

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In 2016, the number of primary human isolates sent to the National Reference Centre for Salmonella decreased by 9.2% as compared to 2015.

Due to the decline of fully susceptible *S*. Enteritidis isolates there has been a shift towards higher resistance rates in recent years in Austria. The highest resistance rates are found against ampicillin, sulphonamides and tetracycline (resistance pattern typical for multiresistant *S*. Typhimurium strains) and against nalidixic acid (low-level ciprofloxacin resistance), which is typical for *S*. Infantis, and several *S*. Enteritidis phage-types.

High level resistances against ciprofloxacin and third generation cephalosporins (cefotaxime, ceftazidime) were still extremely rare. The resistance rates among non-human salmonella isolates are partly considerably higher than those among human strains.

The full report can be found in the long version of the AURES 2016 from page 139 to page 153 (AURES 2016).

Resistance report *Shigella*

Data from the human sector

An activity of the National Reference Centre for *Shigella*

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In Austria 62 cases of shigellosis were reported to the health authorities in 2016. In the same year, a total of 58 *Shigella* isolates were received by the National Reference Centre for *Shigella*. The incidence rate was 0.7 / 100,000 inhabitants; in 2015 an incidence of 1.1 / 100,000 inhabitants was registered. The predominant species was *Shigella sonnei* accounting for 75.9% of all isolates. We detected resistance against ciprofloxacin in 13 strains and resistance to nalidixic acid in 24 isolates. 10 *Shigella* strains were ESBL positive (17.24%).

The full report can be found in the long version of the AURES 2016 from page 154 to page 162 (AURES 2016).

Resistance report *Yersinia*

Data from the human sector

An activity of the National Reference Centre for Yersinia

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In 2016, the Austrian National Reference Centre for Yersinia examined 210 isolates of *Yersinia* spp., of which 153 were of human origin, and 57 from food samples. Of the 153 human isolates, 87 were pathogenic, 66 were non-pathogenic isolates. Among the pathogenic isolates 84 belonged to *Yersinia enterocolitica* and 3 strains to *Y. pseudotuberculosis*. In 2016, the incidence rate for cases confirmed by the National Reference Centre was 1.0 per 100 000 inhabitants. In vitro susceptibility testing revealed no abnormalities – six *Y. enterocolitica* isolates showed resistance to amoxicillin/clavulanic acid, two against co-trimoxazol, two to tetracycline and one to gentamicin.

The full report can be found in the long version of the AURES 2016 from page 163 to page 167 (AURES 2016).

Resistance report Tuberculosis 2016

Data from the human sector

An activity of the National Reference Centre for tuberculosis

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In 2016, a total of 634 cases of tuberculosis (489 confirmed, 56 probable and 89 possible cases) were notified in Austria, which corresponds to an incidence of 7.23/100,000 population. Men were two times more affected than women (9.8/100,000 versus 4.8/100,000 population). A total of 203 cases (32%) where found among native Austrians, 165 cases (26.1%) among Austrian residents born in the WHO region Europe and 266 cases (42%) among residents born outside of the WHO region Europe. The decreasing trend in the tuberculosis incidence among Austrian natives between 2008 and 2016 continued (annual incidence reduction: 5 cases/1 million residents). In 2016, 14 cases of MDR-tuberculosis (including two cases of XDR-tuberculosis) were confirmed among non-native Austrians. Two cases of MDR-tuberculosis were confirmed among Austrian natives.

The full report can be found in the long version of the AURES 2016 from page 168 to page 180 (AURES 2016).

Resistance report *Neisseria gonorrhoeae*

Data from the human sector

An activity of the National Reference Centre for gonococcal

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Due to the rapid emergence of antimicrobial resistance mechanisms in *Neisseria gonorrhoeae* the continuous surveillance of antimicrobial resistance data of *Neisseria gonorrhoeae* is crucial for the control and management of gonorrhea.

In 2016 the Institute for Medical Microbiology and Hygiene of AGES (IMED-WIEN) was mandated in collaboration with the Microbiology Laboratory Möst Innsbruck for the tasks of a national reference laboratory for *Neisseria gonorrhoeae*.

In 2016, data of 187 *Neisseria gonorrhoeae* isolates were evaluated for their antimicrobial susceptibility. The Isolates were provided by 12 Austrian laboratories via a sentinel-system. All isolates showed sensitivity to Ceftriaxone. Resistance rates for Cefixime, Azithromycin and Ciprofloxacin were 4.3%, 4.8% and 64.2% respectively. A total of 19.3% of isolates produced penicillinase (PPNG).

The full report can be found in the long version of the AURES 2016 from page 181 to page 188 (AURES 2016).

Resistance report Yeasts

Data from the human sector

An activity of the National Reference Centre for Yeasts

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Up to now resistance in Candida doesn't seem to be a real threat. In general, the situation in Austria is in concordance with globally reported data. In total, 19 resistant strains were found. Although a higher number of candidemia has been observed, the number of resistant strains is below the numbers of the previous year (33 resistant isolates). Only a small number of strains was resistant against azoles.

Echinocandin resistance has been a rare phenomenon. Only a minor number has been identified as resistant in 2016. Only a few resistant strains were observed, one isolate of *C. parapsilosis* and two *C. glabrata* isolates were resistant against anidulafungin, four *C. albicans* isolates were resistant against micafungin. Thus, the resistance rate is about the same as in 2015.

The full report can be found in the long version of the AURES 2016 from page 189 to page 211 (AURES 2016).

Resistance report Moulds

Data from the human sector

An activity of the National Reference Centre for Moulds

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168 moulds out of sterile body sites and bronchoalveolar lavages were collected from the Medical University Vienna, Department of Laboratory Medicine, the Medical University Innsbruck, Division of Hygiene and Medical Microbiology, the Medical University of Graz and the analyse BioLab GmbH of Linz in 2016. *Aspergillus species*, which were isolated in 70% (117/168), are still the leading causative agents of invasive mould diseases; thereof 74% (87/117) belong to the *Aspergillus fumigatus complex*.

Except one as intermediate susceptible valued *A. clavatus*-isolate, all the tested *Aspergillus* isolates were susceptible to the recommended first line treatment of voriconacole. Apart from *Aspergillus terreus* isolates, which exhibit intrinsic resistance to amphotericin B, 6% (7/117) of *Aspergillus* isolates showed elevated minimal inhibitory concentrations (MIC > 1 mg/l) against amphotericin B (3 *A. fumigatus*-, 2 *A. ochraceus*- 1 *A. xenophilus*- und 1 *A. versicolor*-isolate); 7% (8/117) represented elevated MICs (> 0.125 mg/l) against posaconazole (4 *A. fumigatus*-, 2 *A. niger*, 1 *A. ochraceus*- and 1 *A. clavatus*-isolate) and 26% (8/31) against itraconazole (5 *A. fumigatus*-, 2 *A. niger*- and 1 *A. clavatus*-isolate), respectively. For the first time some of the isolates were tested against isavuconazole, which received marketing authorization in Europe for “the treatment of adult patients with invasive aspergillosis and for the treatment of adult patients with mucormycosis for whom amphotericin B is inappropriate”. The MICs of the 11 *Aspergillus* isolates tested (10 *A. fumigatus*- und *1 A. clavatus*-isolate) were ≤ 0.5 mg/l, which could be valued as susceptible.

Among the non-*aspergillus* isolates elevated MICs above 1 mg/l for amphotericin B, above 0.125 mg/l for posaconazole and above 1 mg/l for voriconazole were detected in 43% (22/51), 69% (35/51) and 26% (11/42), respectively. The two *Mucorales species* (1 *Rhizopus sp.* und 1 *Rhizomucor pussilus*-isolate) tested against isavuconazole showed MICs ≤ 1 mg/l. It must be pointed out that clinical breakpoints are only available for *Aspergillus species* and interpretation of susceptibility testing of non aspergillus moulds is based on *Aspergillus*-specific data.

The full report can be found in the long version of the AURES 2016 from page 212 to page 219 (AURES 2016).

Resistance report of the Austrian HIV Cohort Study
Part 1: Transmission of drug-resistant HIV in Austria

An activity of the association "Austrian HIV Cohort Study "

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Prevalence of Transmitted Drug Resistance is Stabilising at a Low Rate in Austria

Strickner S.[1], Rappold M.[1], Rieger A.[2], Steuer A.[3], Sarcletti M.[4], Geit M.[5], Haas B.[6], Taylor N.[7], Kanatschnig M.[8], Zoufaly A.[9], Zangerle R.[4], for the AHIVCOS Study Group

Prevalence of Transmitted Drug Resistance is Stabilising at a Low Rate in Austria

Objective: To determine the prevalence of transmitted drug resistance (TDR), temporal trends in resistance, and predictors for TDR.

Method: Newly diagnosed patients from 2003 to December 2016 from eight centres were analyzed. Mutations were judged as resistant according to Bennett et al. (WHO 2009 mutation list). For patients with acute or recent infection the year of infection was obtained by the date of primary HIV infection or the median point in time between negative and positive HIV test. For patients with chronic infection the rate of resistance was plotted against the year of the HIV diagnosis.

Results: Overall 2823 of 4537 patients had an amplifiable resistance test. The overall prevalence of TDR was 7.9% (222 of 2823 patients; 95% CI: 6.9%-8.9%). The prevalence of NRTI resistance was 3.3% (2.7%-4.0%), the prevalence of NNRTI resistance was 3.1% (2.5%-3.8%), and the prevalence of PI resistance was 2.0% (1.6%-2.6%). The relative risk of TDR in men who have sex with men compared to heterosexual contacts was 1.5 (95% CI: 1.2-2.0). The prevalence rate of TDR in the 890 patients with acute/recent infection was 8.7% (58 of 667 patients; 6.8%-11.1%). One patient (0.2%) showed TDR against 3 drug classes (K70R; K103N; L90M). The prevalence rate of TDR in the 3624 patients with chronic infection was 7.6% (164 of 2156 patients; 6.6%-8.8%).

Conclusions: The prevalence of TDR among newly diagnosed patients was found to be stabilizing. No difficult to treat cases of TDR has been observed.

The full report can be found in the long version of the AURES 2016 from page 220 to page 230 (AURES 2016).

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Resistance report of the Austrian HIV Cohort Study
Part 2: Resistance development under antiretroviral therapy

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Prevalence of Development of Drug Resistance in HIV infected patients in Austria

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Objective: To determine the prevalence of development of drug resistance, predictors and temporal trends in resistance.

Method: Patients currently in care in one of eight centres who have ever been on antiretroviral therapy (ART) were analyzed. Mutations were judged as resistant according to "2017 Update of the Drug Resistance Mutations in HIV-1" from the International Antiviral-Society-USA (http://iasusa.org/resistance_mutations/mutations_figures.pdf).

Results: Overall 4487 patients have ever received ART, 4483 of them currently. 1270 had a resistance test after ART (28.3%). The overall prevalence of development of drug resistance was 74.6% (948 of 1270 patients), the prevalence of NRTI resistance was 36.9%, the prevalence of NNRTI resistance was 28.0%, and the prevalence of PI resistance was 68.0%. The prevalence of 3-class-resistance was 18.7% (237 of 1270 patients). The risk factors for developing a 3-class-resistance were a CD4 nadir <50 (OR=3.6; 95% CI: 2.4-5.3), a CD4 nadir between 50 and 200 (OR=2.4; 95% CI: 1.7-3.5) and initial therapy before 1997 (OR=25.0; 95% CI: 16.9-37.2) as well as from 1997 to 2003 (OR=7.6; 95% CI: 5.0-11.4) and an age at ART-start <30 (OR=2.1; 95% CI: 1.1-3.9). The risk to develop a 3-class-resistance was lower in patients with a low viral load (for <400 copies/ml OR=0.2; 95% CI: 0.1-0.4) and in male (OR=0.5; 95% CI: 0.3-0.9) and female (OR=0.5; 95% CI: 0.2-0.96) patients infected through intravenous drug use.

Conclusions: The overall prevalence of development of drug resistance is at a rather high level, while the prevalence of 3-class-resistance was found to be stabilizing at a low level. The risk for developing resistance is small in those who initiated therapy in recent years.

The full report can be found in the long version of the AURES 2016 from page 231 to page 249 (AURES 2016).

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Report of antibiotic resistance monitoring according to the commission implementing decision 2013/652/EU in Austria, 2016

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In accordance with EU-Directive 2003/99/EC, the Federal Ministry of Health and Women's Affairs in cooperation with the Austrian Agency for Health and Food Safety (AGES) and officially designated veterinary practitioners conducted annual programs in order to monitor the prevalence and the antimicrobial resistance of certain zoonotic and indicator bacteria in different Austrian farm animal species. Since 2014, based on the Commission Implementing Decision No. 2013/652/EU the member states have to monitor and report antimicrobial resistance in zoonotic and commensal bacteria isolated from samples of food producing animals and from food. In 2016, slaughter batches of broilers and turkeys were analyzed for *Campylobacter* (*C.*) *jejuni*, commensal *E. coli*, β-lactamase and carbapenemase producing *E. coli*, as well as batches of fresh chicken meat sampled at retail for β-lactamase and carbapenemase producing *E. coli*. Additionally, all *Salmonella* isolated from flocks of laying hens, broilers and turkeys in the course of the *Salmonella* control program but also *Salmonella* from carcasses both broilers and turkeys obtained by food business operators at slaughterhouses in accordance with process hygiene criteria had to be tested within the Decision 2013/652/EU. In the respective national reference laboratories the obtained isolates were specified or typed and tested for their antimicrobial susceptibility.

In Austria, randomized, representative samples of slaughtered broiler flocks and turkey flocks, caecum content of ten animals per flock pooled were investigated for *C. jejuni*, indicator *E. coli* and β-lactamase and carbapenemase producing *E. coli*. One *C. jejuni* isolate each from 174 broiler flocks and 55 turkey flocks, obtained from 491 broiler flocks and 199 turkey flocks was susceptibility tested. Twenty point one percent of *C. jejuni* isolates from chicken and 10.9% from turkey showed susceptibility to all six antimicrobials tested. Isolates from both animal species showed similar resistance patterns with very high to extremely high resistance rates to quinolones and tetracyclines. Higher resistance rates were found in isolates from broiler compared to turkeys towards quinolones (ciprofloxacin: 77.6% versus 74.5% and nalidixic acid: 73.0% versus 63.6%); towards tetracycline turkey isolates presented higher resistance rates (54.5% versus 50.0%). Since 2004, a significant increasing tendency in resistance can be found in isolates from broilers to ciprofloxacin and nalidixic acid, and since 2012 significant tendency was detected towards tetracycline. In 2014, turkey isolates were tested for the first time; therefore longer term tendency cannot be analyzed.

Commensal *E. coli* from 170 broiler flocks and 154 turkey flocks were susceptibility tested against 14 antimicrobial substances. No microbiological resistance to all tested antimicrobials could be found in 33.5% of broiler isolates and 42.2% of turkey isolates; that indicates an improvement of the resistance situation in Austria compared to 2014 (21% of broiler isolates and 30% of turkey isolate were fully susceptible). Isolates from chicken compared with turkey showed higher resistance rates to ciprofloxacin (47.1% versus 22.7%), nalidixic acid (45.3% versus 16.9%), sulfamethoxazole (37.1% versus 18.2%), and trimethoprim (29.4% versus 11.0%), although higher resistance rates to tetracycline (40.9% versus 22.4%) were detected in turkey isolates. Resistance rates to the other antimicrobials tested were similar in isolates from both poultry species, e. g. to ampicillin (32.9% versus 31.8%) or chloramphenicol (4.7% versus 8.4%). Since 2010, resistance rates to quinolones in chicken isolates significantly decreased; since 2004 a significant increasing tendency of resistance towards ampicillin, sulfonamides and trimethoprim has been observed but towards tetracycline a significant decreasing tendency has been determined. In 2014, turkey isolates were analyzed for the first time.

β-lactamase producing *E. coli* were found following selective enrichment in 52.3% of 306 tested broiler flocks, in 63.7% of 300 chicken meat samples and 43.7% of 183 turkey flocks. Among the β-lactamase producing *E. coli*, the ones with extended spectrum (ESBL) were most commonly identified (51% of all positive samples each in broiler flocks and in chicken meat, 74% in turkey flocks), followed by plasmid coded AmpC (pAmpC) β-lactamase producing *E. coli* (43% and 46% of isolates from broilers and chicken meat and 20% of isolates from turkeys). AmpC-, ESBL+AmpC-β-lactamase producing *E. coli* or other phenotypes (putative non ESBL/AmpC producers) are distributed among the other isolates.

Carbapenemase producing *E. coli* could not be detected following selective enrichment in any broiler flock, chicken meat sample and turkey flock.

All commercially produced flocks of layers, broilers, and turkeys are controlled for salmonella. For susceptibility testing, 46 *Salmonella* isolates from layers, 179 from broilers, and eleven from turkeys were available. At slaughterhouses 36 *Salmonella* isolates were detected on broiler carcasses but none on turkey carcasses. Of all isolates tested, 84.8% *Salmonella* isolates from layers, 45.3% from broilers, 54.5% from turkeys and 52.8% from broiler carcasses were fully susceptible against all 14 antimicrobial substances tested. Compared to 2014, the resistance situation improved in isolates of all populations tested. The detection of resistance in all *Salmonella* isolates from poultry corresponds with the occurrence of certain serovars e. g. *S*. Infantis, *S*. Typhimurium including the monophasic variant, *S*. Mbandaka, *S*. Saintpaul, and *S*. Stanley and the decrease of fully sensitive serovars like most *S*. Enteritidis and *S*. Montevideo. Significant tendencies in resistance rates of *Salmonella* spp. are difficult to determine because resistances are often linked to certain serovars.

The full report can be found in the long version of the AURES 2016 from page 250 to page 346 (AURES 2016).

European Surveillance of Veterinary Antimicrobial Consumption (ESVAC)

An activity of AGES – Agency for Health and Food Safety
Department data, statistics and risk assessment

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In 2016, the total sales of active ingredients in Austria for livestock equal 44.41 tons (t), a decrease of 9.0 % compared to 2015. The largest amount of veterinary antimicrobials was for systemic use (41.52 t, 94 %). Within the group for systemic use more than half were tetracyclines, followed by penicillins with extended spectrum, sulfonamides and macrolides.

Oral preparations – this group includes oral powders, oral solutions, tablets and oral pastes – are with 35.55 tons (80 %) still the most used application form. Parenteral preparations are on second place with 5.69 tons (12.8 %), followed by premix with 1.90 tons (4.3 %).

The full report can be found in the long version of the AURES 2016 from page 347 to page 353 (AURES 2016).

Antimicrobial Consumption in Human Medicine in Austria

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Apart from the consumption data provided by the Hauptverband der österreichischen Sozialversicherungsträger (The Organisation of Austrian Social Security), in the present AURES, there were for the first time also assessed the antibiotics consumption data provided by the IMS Health Marktforschung GmbH. The results of both sources were then comprehensively evaluated and depicted in regard to sectors, substances, reference figures and seasonal fluctuations.

The systemic overall consumption of antibiotics in Austria amounted in the year 2016 in the field of human medicine, hence, to 71.602t active ingredients, with 67% thereof accounting for registered practitioners and 33% for the hospital sector.

In retrospect, and in view of the data of 2010, overall consumption has increased from 69.158t to 71.602t active ingredients, wherein this increase mainly took place in the hospital sector (by 15.5%, from 20.5t in the year 2010 to 23.5t in the year 2016). Consumption with registered practitioners, however, has remained essentially the same within the same period.

Consumption density in Austria in 2016 was 20.58 DDD/1,000 inhabitants per day, thus having decreased since 2010 by 6.45% (22 DDD/1,000 inhabitants per day) or, in comparison with 2015, the prescriptions per 10,000 inhabitants per day have decreased from 17.3 to 16.5, respectively.

The major part of overall consumption with 53% for β-lactam antibiotics, penicillins (J01C), hence, shows a tendency of being stable towards slightly increasing (2010: 10.73 DDD/1,000 inhabitants per day; 2016: 10.91 DDD/1,000 inhabitants per day). For other antibiotics of the ATC3 group J01, there has been observed a reduction of consumption. The dominance of ß-lactam antibiotics, penicillins (J01C), is also being reflected in the sector of registered practitioners (2016: 8.98 DDD/1,000 inhabitants per day), followed by the group of macrolides, lincosamides and streptogramins (J01F) (2016: 3.15 DDD/1,000 inhabitants per day). In the hospital sector, the ß-lactam antibiotics, penicillins (J01C), also show the highest consumption (J01C) (2016: 33.39 DDD/100 occupancies per year), followed by other ß-lactam antibiotics, cephalosporines (2016: 11.60 DDD/100 occupancies per year).

An analysis of the monthly consumption dates of the year 2016 shows a fluctuation in correlation with the various seasons. Significant fluctuation ranges were shown with ß-lactam antibiotics, penicillins (J01C), other ß-lactam antibiotics, cephalosporines (J01D), and the group of the macrolides, lincosamides and streptogramins (J01F) as well as with quinolones (J01M). In the year 2016, the largest fluctuation range of overall consumption was observed with 65.5% for the macrolides, lincosamides and streptogramins (J01F), followed by the ß-lactam antibiotics, penicillins (J01C) with 31.2%, other ß-lactam antibiotics, cephalosporines (J01D) with 23.3% and quinolones (J01M) amounting to 18.9%.

The results of the season fluctuations in the sector of registered practitioners were similar to those of overall consumption. The largest fluctuation range was to be assigned to the group of the macrolides, lincosamides and streptogramins (J01F) (70%), followed by ß-lactam antibiotics, penicillins (J01C) with 37.4%, other ß-lactam antibiotics, cephalosporines (J01D) with 35.3% and quinolones (J01M) with 22.2%. In the hospital sector, there were hardly observed any seasonal fluctuations, with the exception of the group of the macrolides, lincosamides and streptogramins (J01F) with 10.9%.

The analysis of the carbapenems showed in 2016 a hospital-related consumption of 2.47 DDD/100 occupancies per year, with meropenem representing the most-used substance (only 0.47% of overall consumption may be assigned to the sector of registered practitioners).

Finally, the focus was laid on the consumption of “reserve antibiotics” in the hospital sector. For the active ingredients, which are used for the gram-positive types, the consumption of linezolid increased during the period of the study, while the consumption of vancomycin was decreasing. In the gram-negative area, there was mainly visible an increase of consumption of meropenem and cefepim, while the consumption of the other active ingredients has been decreasing (imipenem/cilastatin, doripenem, ertapenem, cefpirom).

The full report can be found in the long version of the AURES 2015 from page 354 to page 381 (AURES 2016).

Resistance report *Erwinia amylovora*

An activity of AGES –Austrian Agency for Health and Food Safety
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Fire blight is caused by the plant pathogenic bacterium *Erwinia amylovora*. The use of streptomycin as a plant protection agent constitutes one part of the Austrian strategy to combat this plant disease in fruit growing. In order to determine the prevalence of streptomycin resistant *E. amylovora* strains at an early stage, surveillance activities have been carried out since 2006. Up to date, all *E. amylovora* isolates from treated orchards have been tested as susceptible to streptomycin. The comparison of the distribution of minimum inhibitory concentrations between wild-type strains and test-strains did not reveal any shifting of the sensitivity range of the tested isolates.

The full report can be found in the long version of the AURES 2016 from page 382 to page 389 (AURES 2016).

OVERVIEW CONTRIBUTIONS, AUTHORS AND REVIEWERS

Table 2: Contribution summary, with authors and reviewers

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