Antimicrobial Consumption and Resistance in Malta

ANNUAL REPORT 2022

National Antibiotic Committee
Malta

Contents

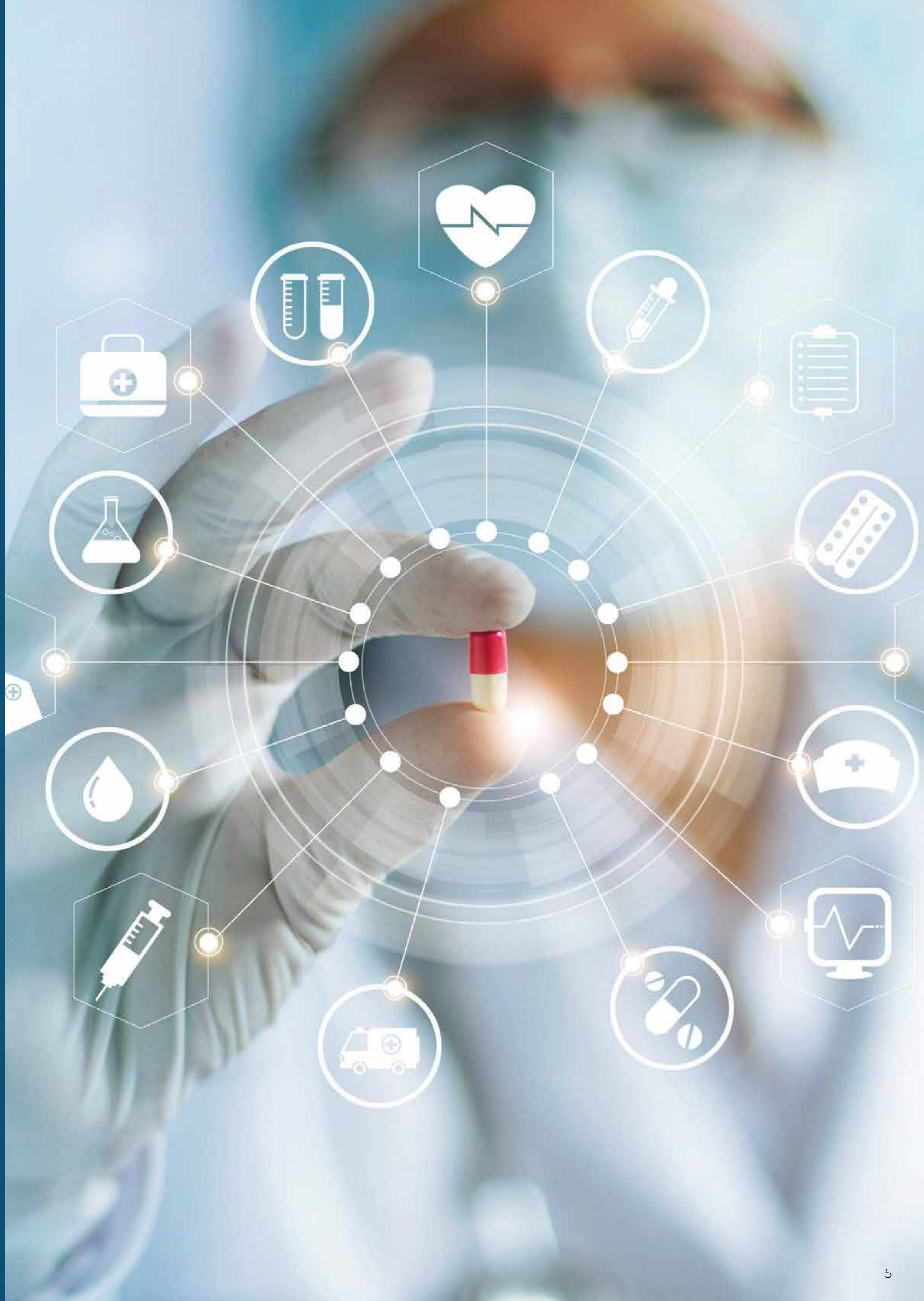
Executive Summary

IN HUMAN HEALTH

- The reduction of meticillin resistance in *Staphylococcus aureus* (MRSA) of recent years was maintained, although the suspension of admission screening at Mater Dei Hospital due to COVID-19 may explain the slight uptick.
- After a period of sustained increase, a welcome reduction was observed in *Escherichia coli* and *Klebsiella pneumoniae* strains resistant to fluoroquinolones (e.g. ciprofloxacin) and cephalosporins (e.g. cefuroxime and ceftazidime) over the past three years.
- Incidence of carbapenem resistance in *Klebsiella pneumoniae* has also decreased over the past two years. Carbapenem-resistant Enterobacterales (CRE) strains now constitute just above 5% of *Klebsiella pneumoniae* isolates, a threefold reduction since 2018.
- Resistance in *Pseudomonas aeruginosa* continues to maintain relatively low levels especially to carbapenems
- The past two years have shown a sudden surge in *Enterococcus* infections, resistant to glycopeptides (VRE), which were previously very rare in Malta. This is a new and worrying development.
- Full resistance to penicillin in *Streptococcus pneumoniae* remains at low levels, including in invasive isolates such as blood cultures. However, macrolide resistance continues to increase to levels where empiric treatment of respiratory infection with these antibiotics is no longer viable.
- *Salmonella* spp. isolates are showing a constant increase in resistance to quinolones and cephalosporins.
- Overall antibiotic consumption in ambulatory (community) care has been relatively stable for the past years
- A high predominance of broad-spectrum antibiotic prescribing continues to be seen, particularly consumption of macrolides (clarithromycin/ azithromycin) as well as quinolones (levofloxacin/ ciprofloxacin) being among the highest in Europe. This level of consumption is not explained by AMR epidemiology
- Consumption of antibiotics in hospital care has increased dramatically in recent years, with the increase being primary in second and third line formulations

IN ANIMAL HEALTH

- Data on resistance is less comprehensive than that in human health
- Nevertheless, resistance levels in some *Salmonella* serotypes are among the highest in the EU
- Preliminary antibiotic use statistics suggest that local consumption is significantly higher than EU average



1 Introduction

The National Antibiotic Committee has been set up since 2008 in accordance to the legal notice L.N.122 as part of the Public Health Act (Cap.465). The duties of the Committee are to:

- Promote the understanding of, and support for, correct prescribing, dispensing and use of antibiotics amongst medical, pharmaceutical and veterinary professionals as well as the public at large.
- Coordinate strategies to ensure the continued effectiveness of antibiotic agents used in the treatment and prevention of infectious diseases in humans and animals.
- Develop and recommend strategies to comply with directives and recommendations issued by the European Union on antibiotic use and resistance.
- Advise the Superintendent of Public Health on measures necessary to minimise antimicrobial resistance.
- Foster the development of written guidelines and recommendations for evidence-based use of antibiotics in both hospitals and community settings.
- React in a timely and realistic way to acute problems in the field of antimicrobial resistance as they arise.
- Keep abreast of the latest research and recommendations on antibiotic use and resistance and disseminate such information.
- Tender all such advice as may be requested by the Superintendent of Public Health.

This report provides data on antimicrobial resistance (AMR) epidemiology and antimicrobial consumption. In the case of human health is being presented for the last 13 years. With respect to animal health, antimicrobial resistance monitoring and surveillance, in accordance to Commission legislation started in 2015, whereas data collection on antimicrobial consumption started in 2017.

Data collated for human health is being represented in this report in line with the initial list of proposed AMR and antimicrobial consumption indicators as outlined in European Centre for Disease Prevention and Control (ECDC), European Food Safety Authority (EFSA) and European Medicines Agency (EMA) Joint Scientific Opinion (2017)

2 Human Health

2.1 AMR Epidemiology

Staphylococcus aureus

Historically, Malta has registered one of the highest prevalence of MRSA in Europe. For many years, the proportion of meticillin resistance in blood cultures was greater than 50%. However, since 2010, several interventions undertaken by Mater Dei Hospital, especially the introduction of universal admission screening and decolonisation, have yielded positive results.

This is evident in a consistent reduction of MRSA proportions in *S. aureus* isolated from hospital patients which has now reached 20%. The reduction has also been mirrored in the community where MRSA proportions have reduced concurrently.

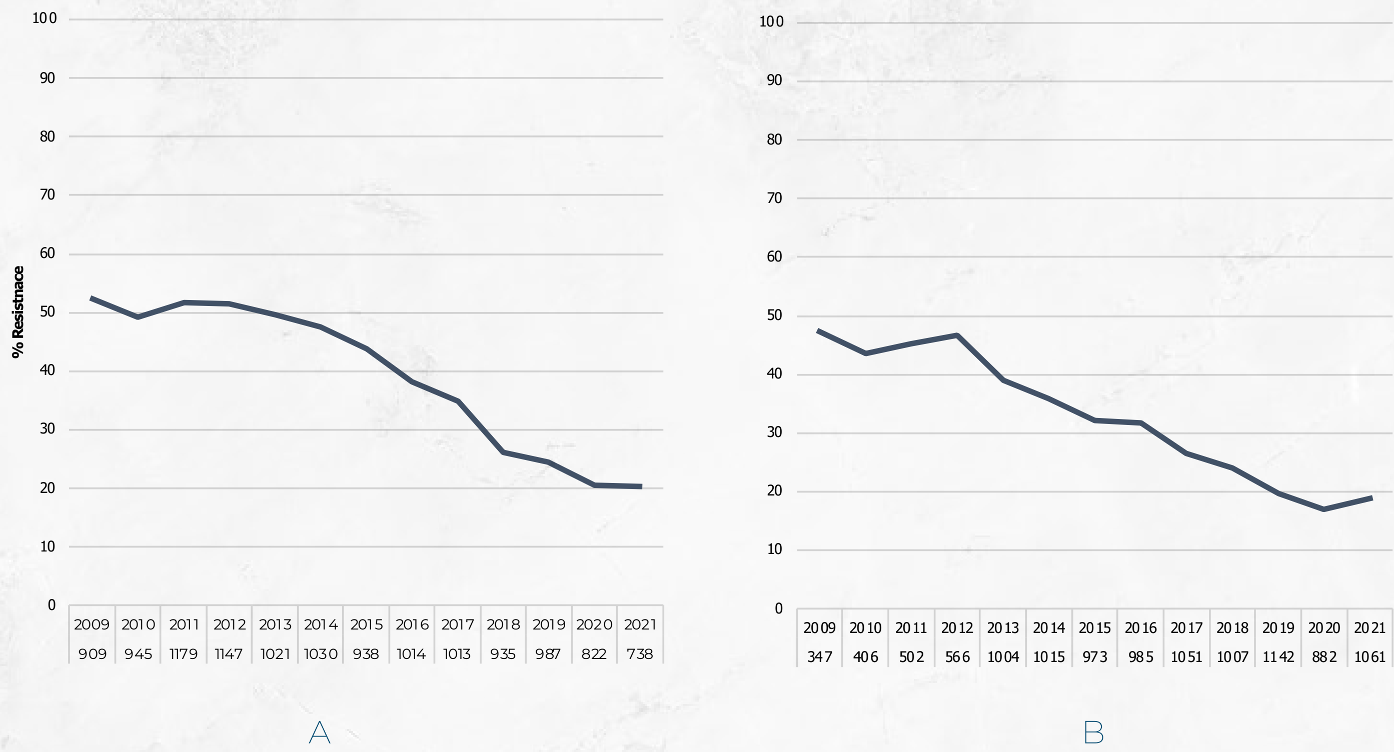


Fig 1: Proportion (in percentage) of oxacillin resistance in *Staphylococcus aureus* isolated from all clinical samples in (a) hospital and in (b) community isolates in Malta, 2009-2021

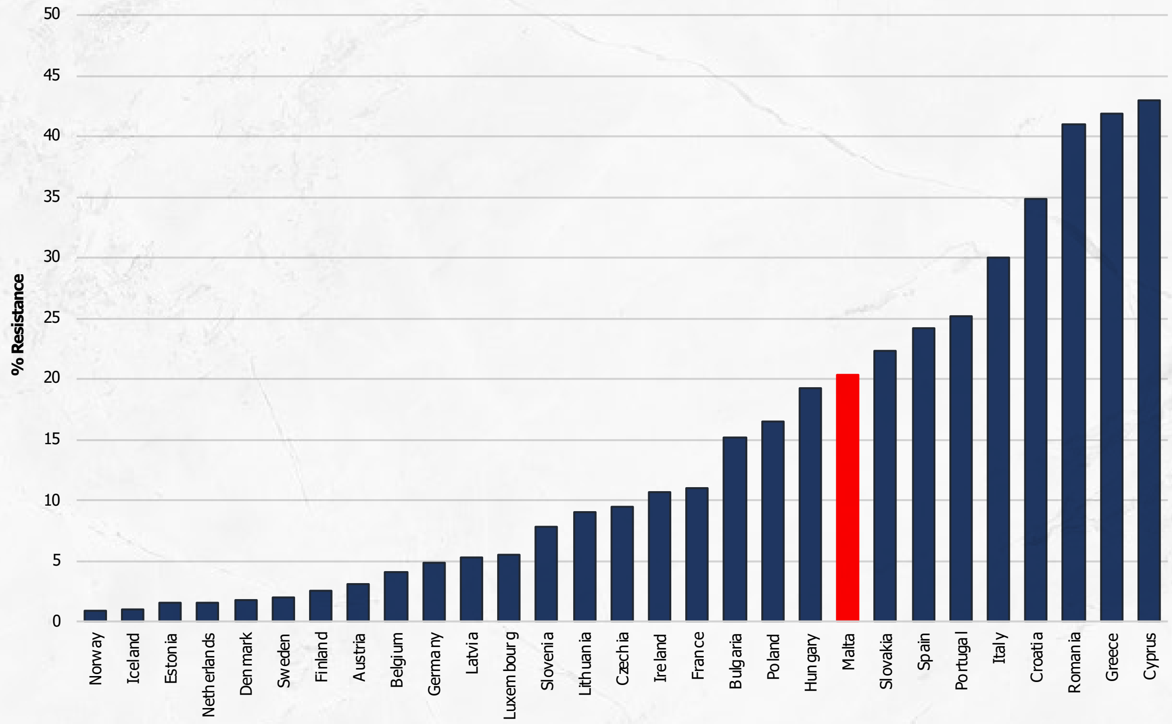
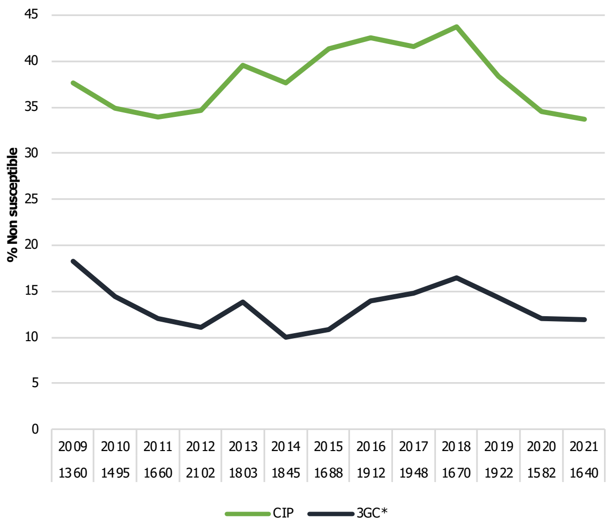


Fig 2: Percentage (%) of invasive isolates with resistance to methicillin (MRSA), in Malta and European Union/ European Economic Area (EU/EEA) countries (Source: EARS-Net Report 2021)

Escherichia coli

Resistance in *Escherichia coli* in both community and hospital isolates remains problematic. Almost 30% of community strains of *Escherichia coli* isolated in 2021 exhibited resistance to ciprofloxacin, while resistance to third generation cephalosporins (suggesting extended spectrum beta-lactamase (ESBL) activity) occurred in approximately 10% of isolates. In hospital strains, the situation is worse. However, both cephalosporin and quinolone resistance in hospital isolates showed a significant improvement in recent years.



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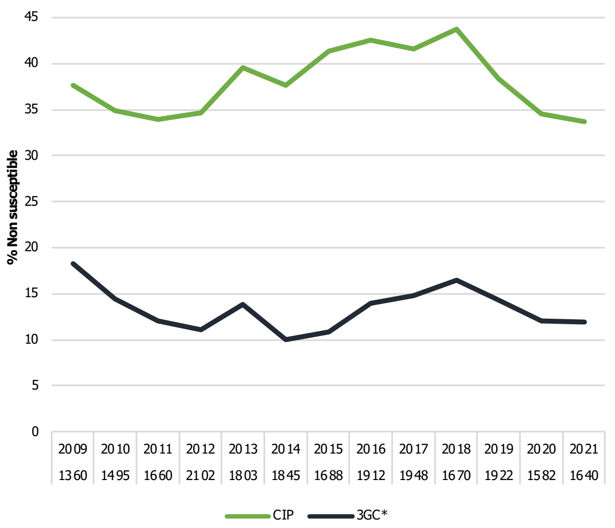
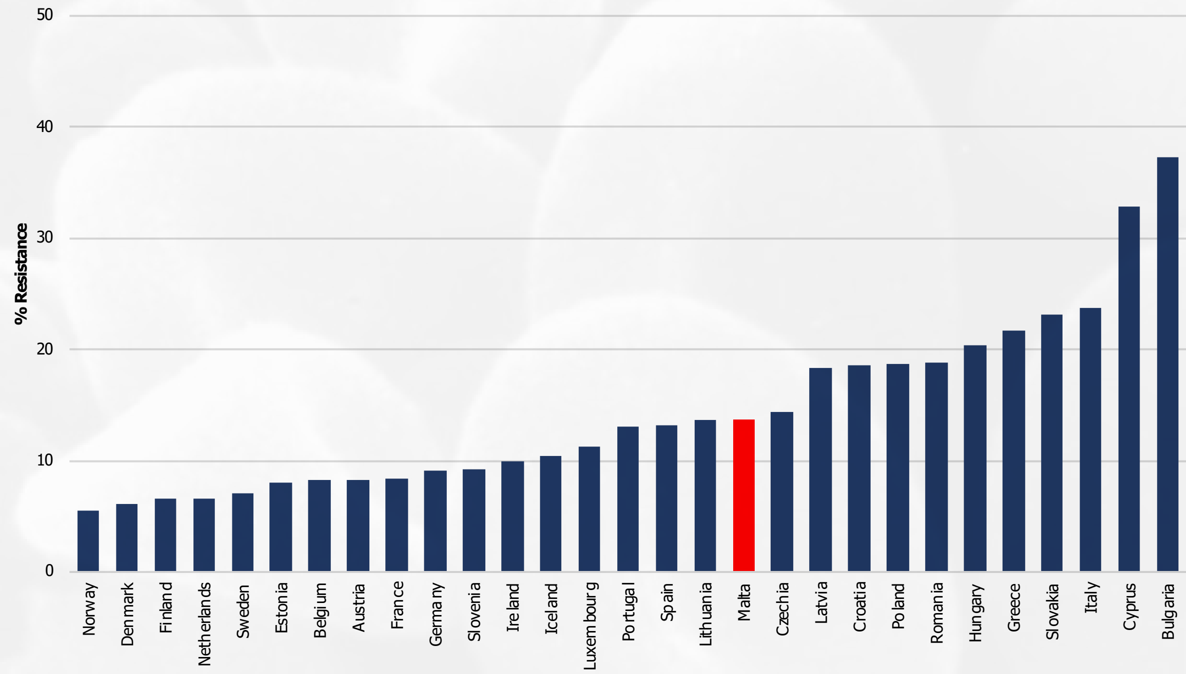


B

Fig 3: Total number of isolates tested (N) and percentage (%) of non-susceptible *Escherichia coli* isolated from all clinical samples from (a) hospital and (b) community, in Malta, 2009-2021

CIP ciprofloxacin; 3GC* 3rd generation cephalosporin



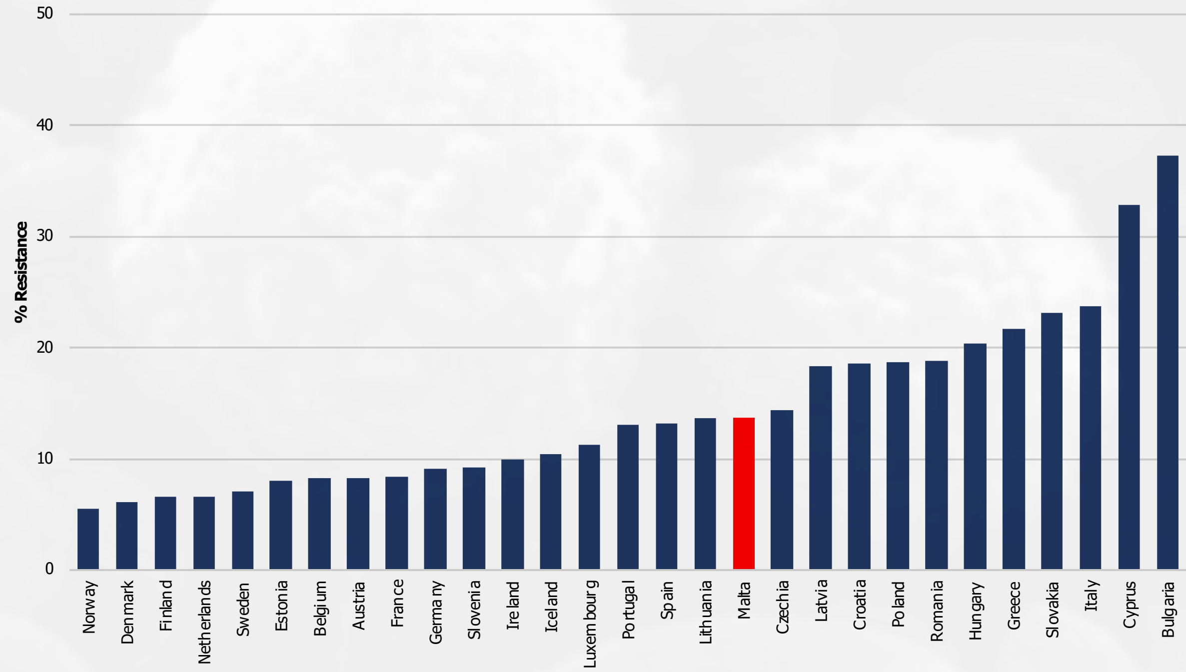
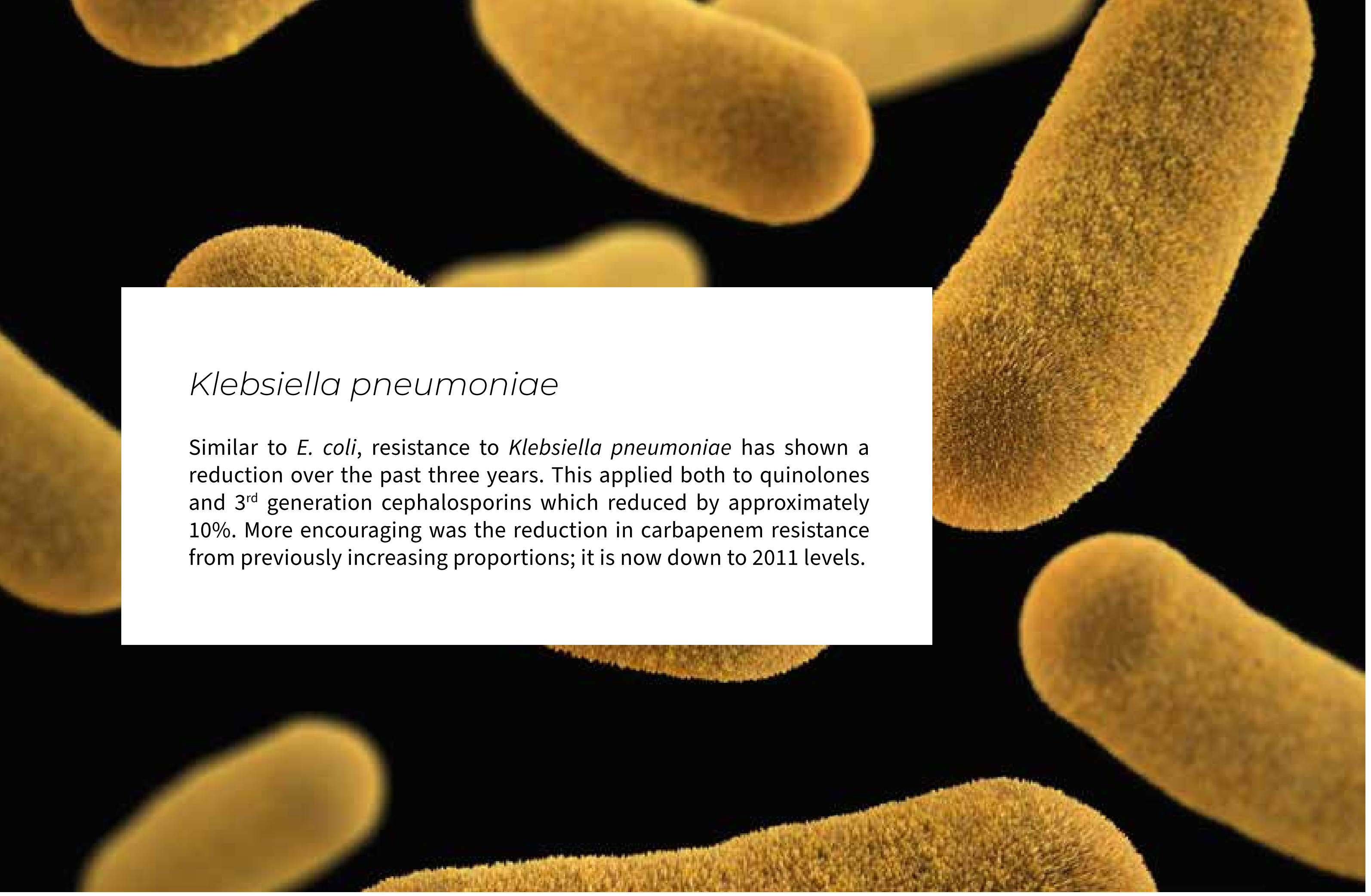


Fig 4: Percentage (%) of invasive isolates with resistance to 3rd generation cephalosporin, in Malta and EU/EEA countries (Source: EARS-Net Report 2021)



Klebsiella pneumoniae

Similar to *E. coli*, resistance to *Klebsiella pneumoniae* has shown a reduction over the past three years. This applied both to quinolones and 3rd generation cephalosporins which reduced by approximately 10%. More encouraging was the reduction in carbapenem resistance from previously increasing proportions; it is now down to 2011 levels.

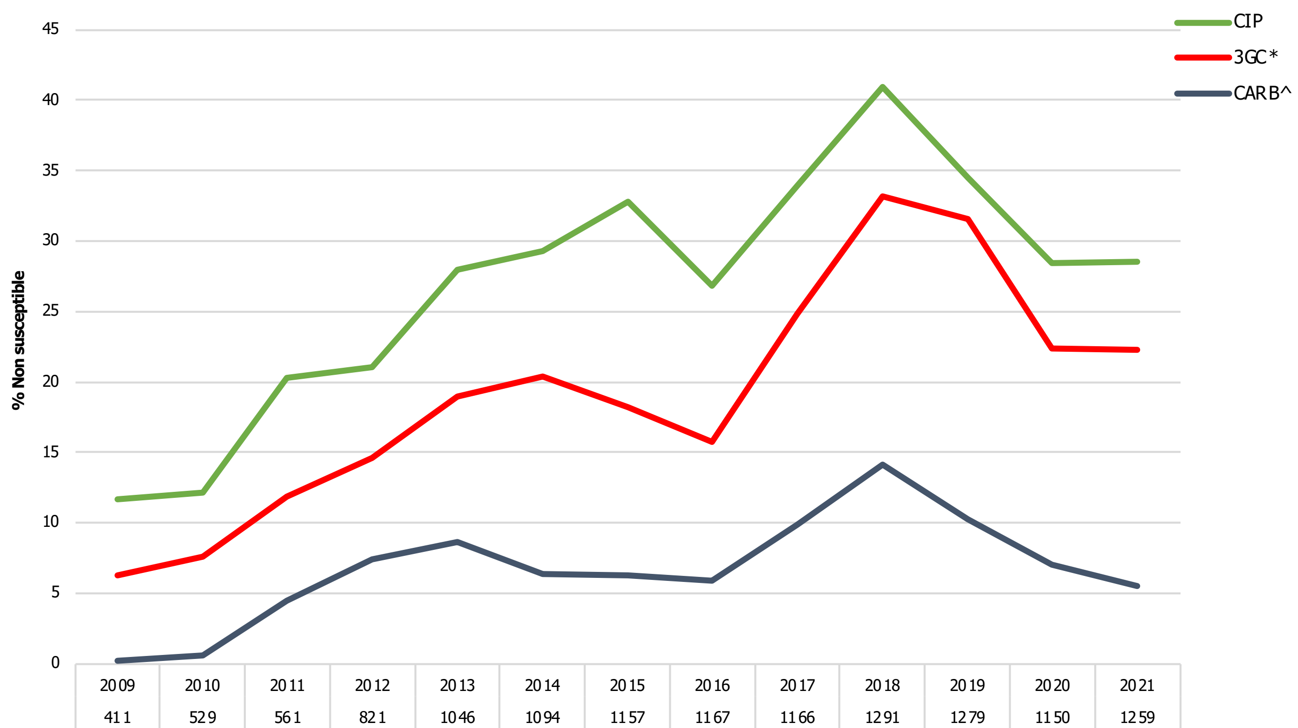


Fig 6: Total number of isolates tested (N) and percentage (%) of non-susceptible *Klebsiella pneumoniae* in all clinical samples from hospital and community isolates, in Malta, 2009-2021

CIP ciprofloxacin; 3GC* 3rd generation cephalosporin; CARB^ carbapenem

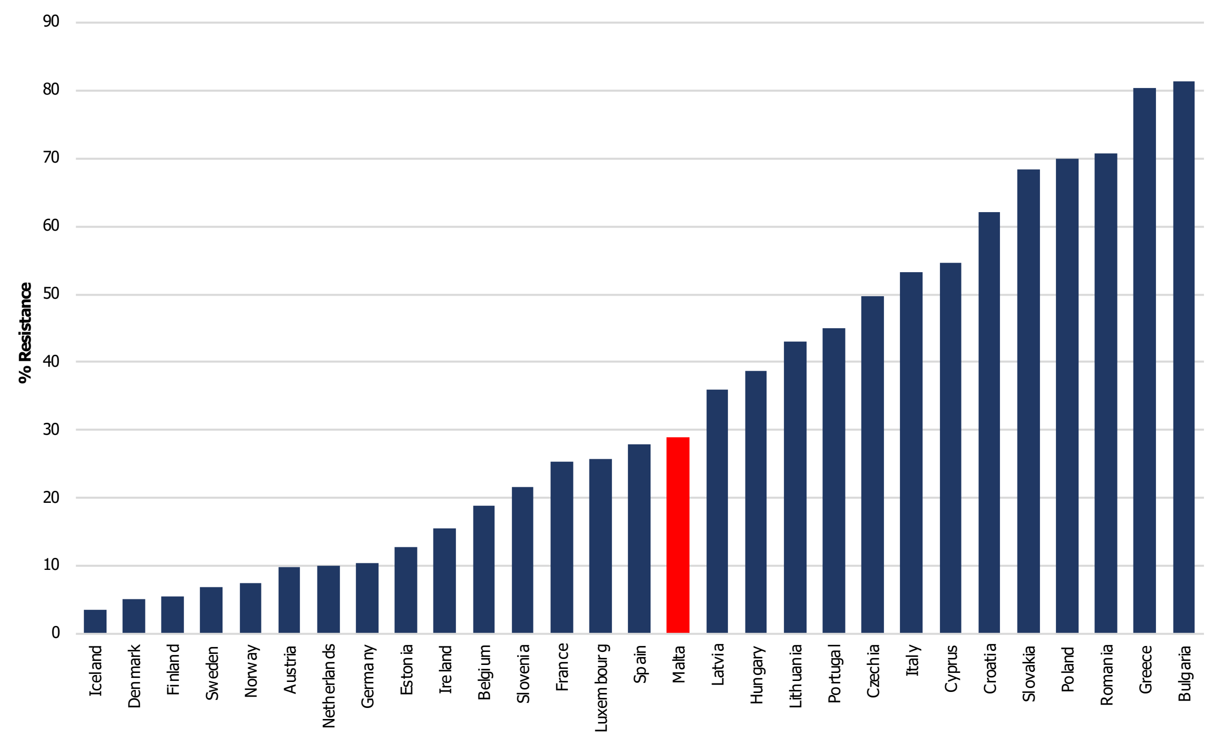


Fig 7: Percentage (%) of invasive isolates with resistance to 3rd generation cephalosporin, in Malta and EU/EEA countries (Source: EARS-Net Report 2021)

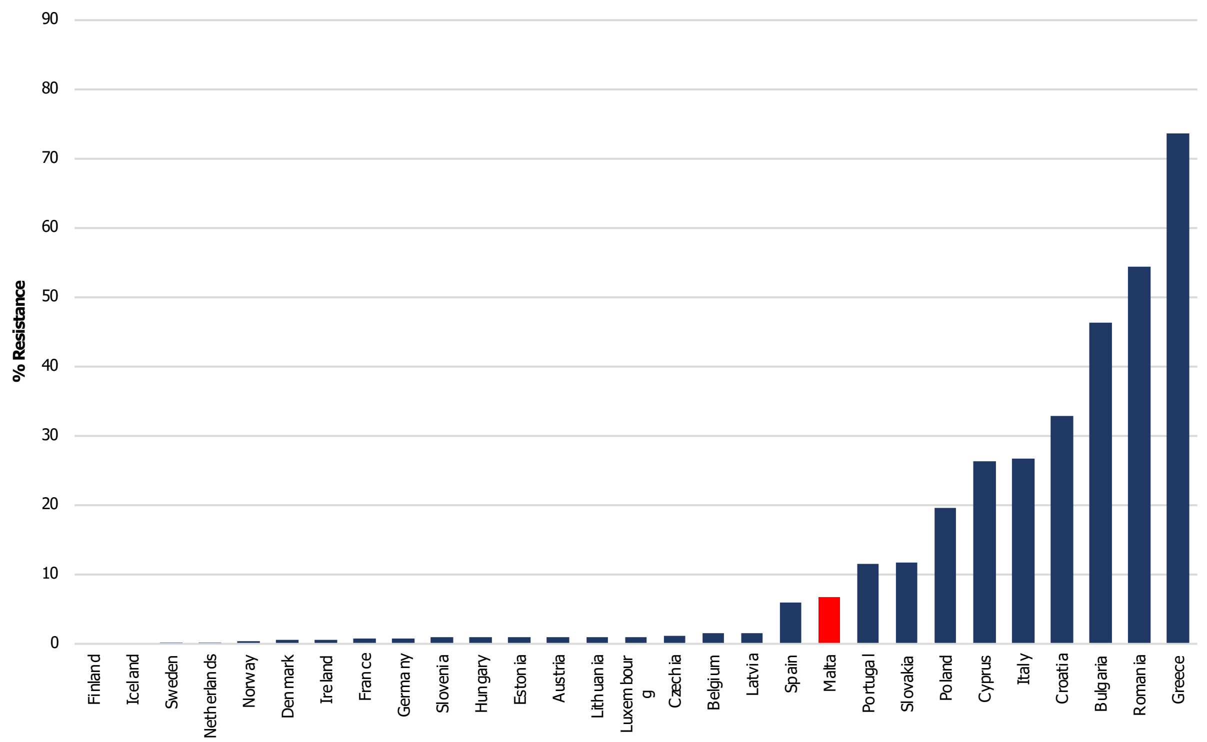


Fig 8: Percentage (%) of invasive isolates with resistance to carbapenems, in Malta and EU/EEA countries (Source: EARS-Net Report 2021)

Streptococcus pneumoniae

Penicillin non-susceptibility in *Streptococcus pneumoniae* continued to decrease to very low levels. However, resistance to macrolides now exceeds 45%; the highest in the EU/EEA.

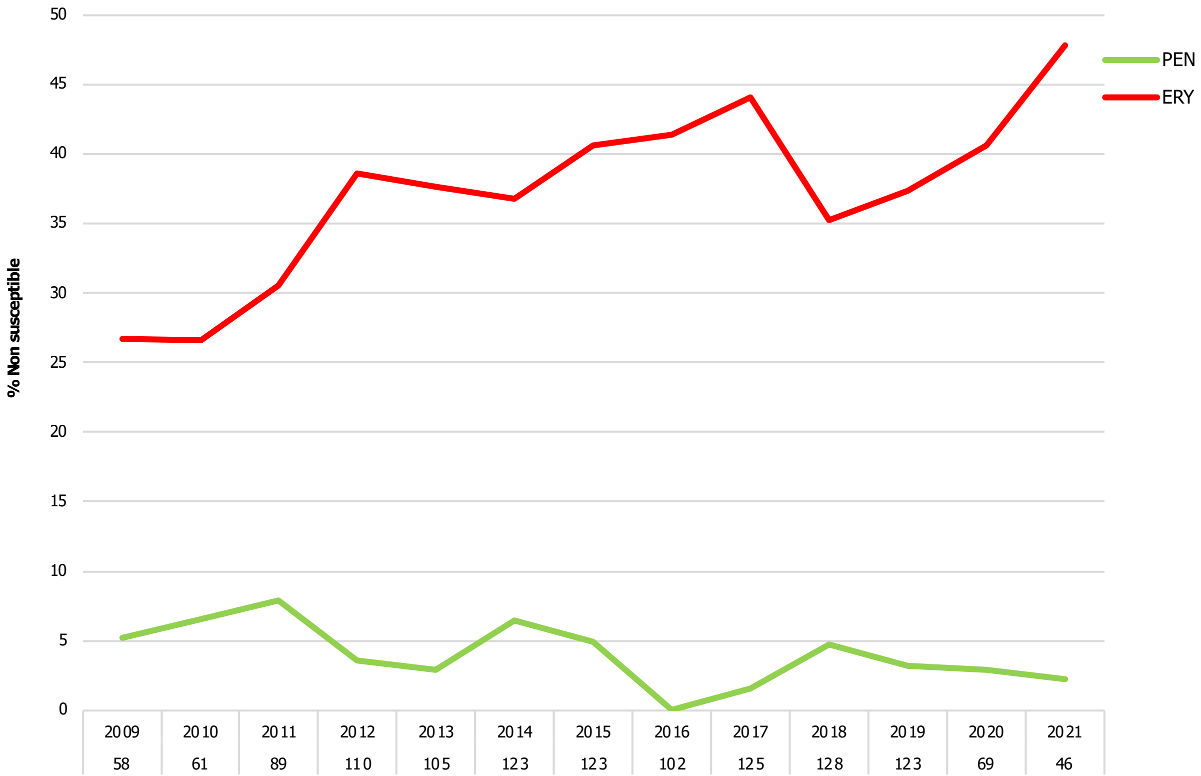


Fig 9: Total number of isolates tested (N) and percentage (%) of non-susceptible *Streptococcus pneumoniae* in all clinical samples from hospital and community isolates, in Malta, 2009-2021

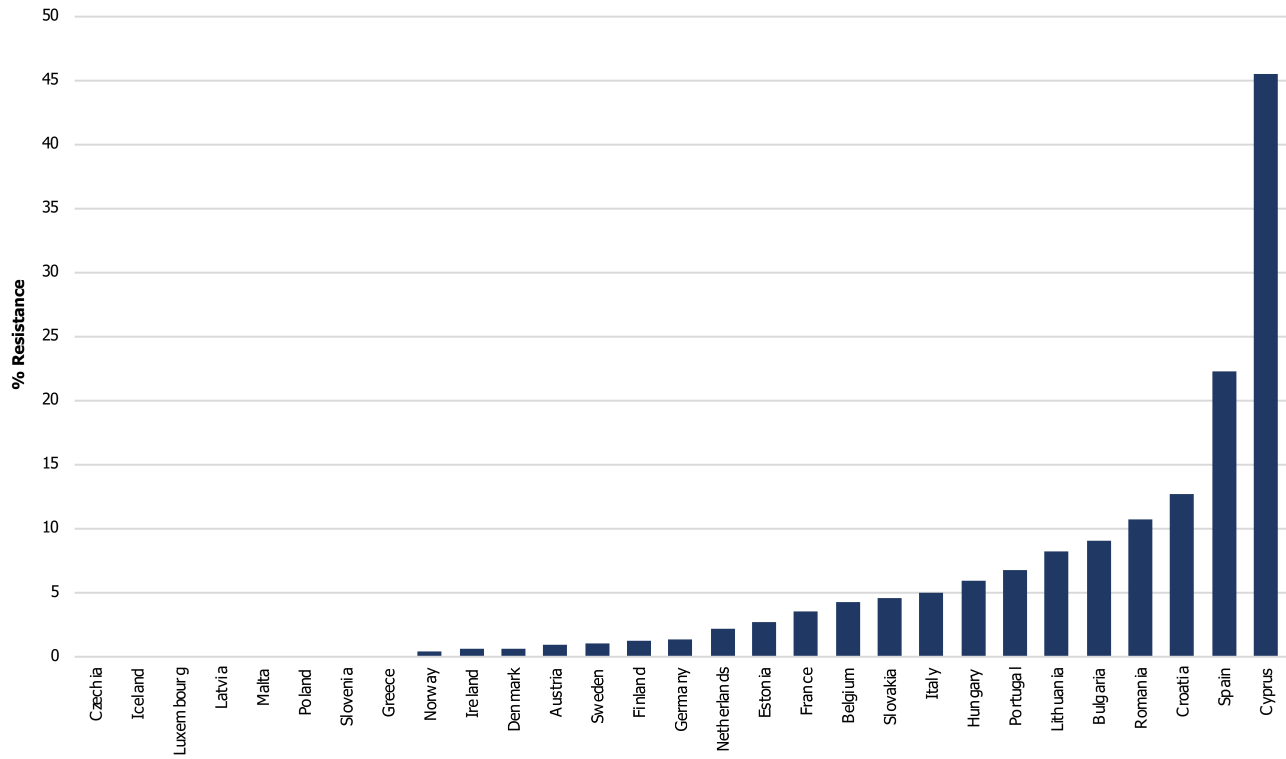


Fig 10: Percentage (%) of invasive isolates with resistance to penicillin, in Malta and EU/EEA countries (Source: EARS-Net Report 2021)

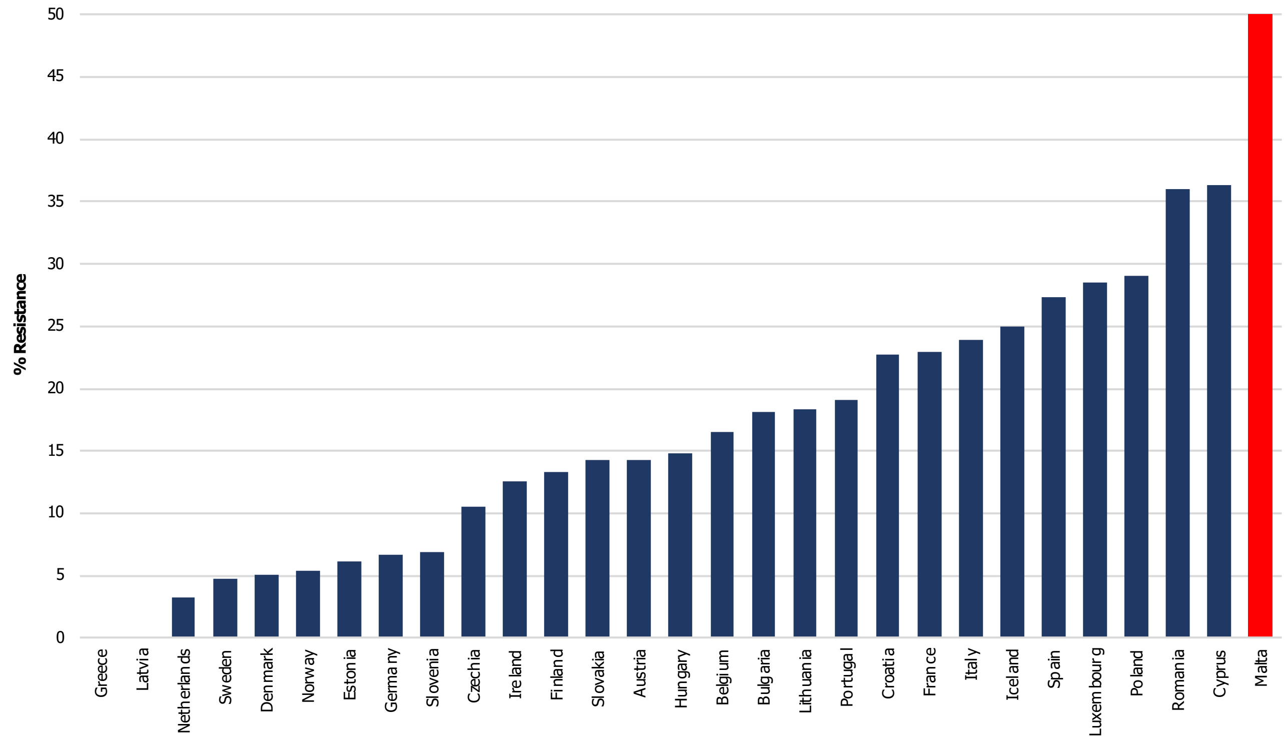


Fig 11: Percentage (%) of invasive isolates with resistance to macrolides, in Malta and EU/EEA countries (Source: EARS-Net Report 2021)

Pseudomonas aeruginosa

Resistance in *Pseudomonas aeruginosa* remains relatively low, even to ciprofloxacin and 3rd generation cephalosporins. Carbapenem resistance remains stable at around 2%. Resistance in invasive isolates appear to be much more (11%), however the number of isolates there is low, which increase the random error.

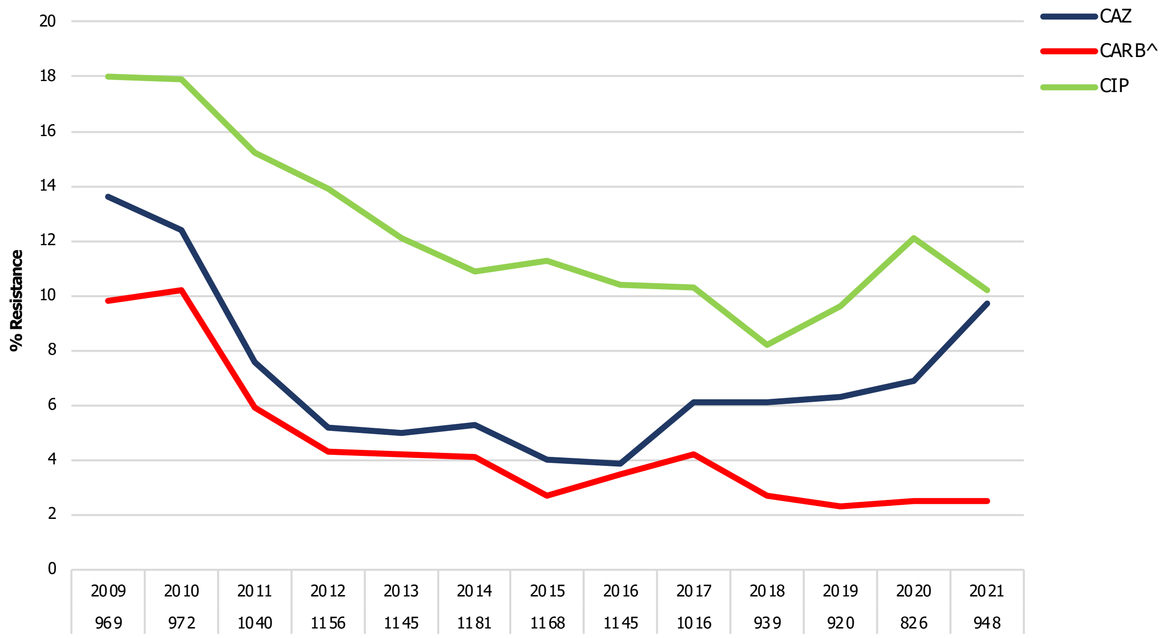


Fig 12: Total number of isolates tested (N) and percentage (%) of resistant *Pseudomonas spp.* in all clinical samples from hospital and community isolates, in Malta, 2009-2021

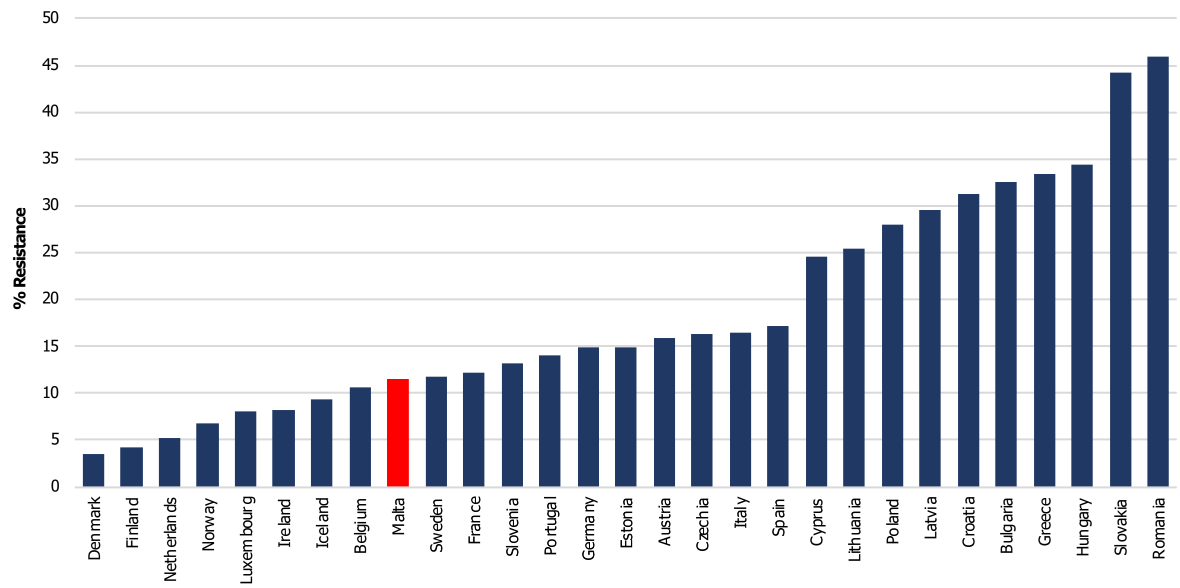


Fig 13: Percentage (%) of invasive isolates with resistance to carbapenem, in Malta and EU/EEA countries (Source: EARS-Net Report 2021)

Enterococcus faecium

Resistance in *Enterococcus faecium*, especially vancomycin-resistant enterococci (VRE), has exploded over the last three years. It is now one of the main multidrug resistance challenges in hospital care.

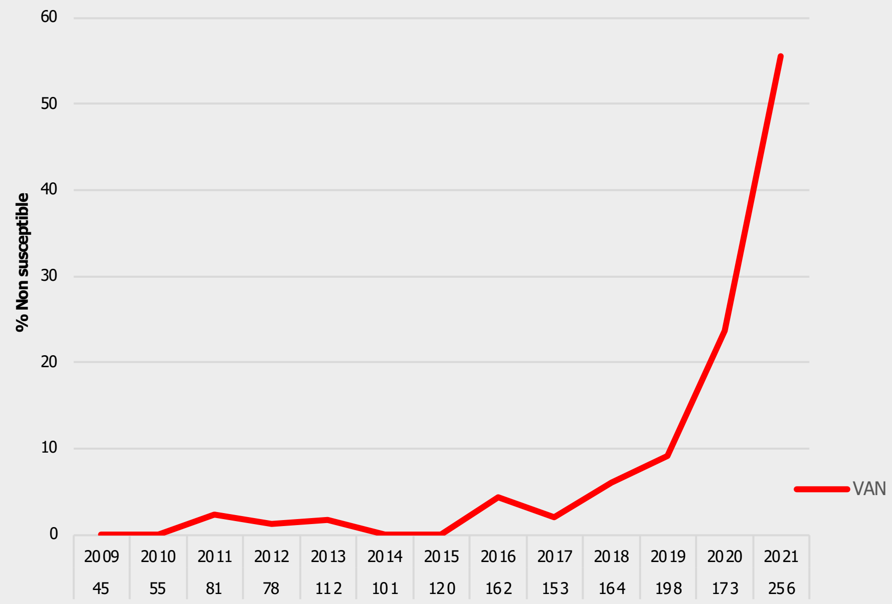


Fig 14: Total number of isolates tested (N) and percentage (%) of non-susceptible *Enterococcus faecium* in all clinical samples from hospital and community isolates, in Malta, 2009-2021

VAN vancomycin

Salmonella spp.

The reducing trend in resistance among human strains of *Salmonella spp*. continued in past years with a significant drop in both quinolone and cephalosporin resistance. No ESBL- positive *Salmonella* isolates were identified in 2021.

Fig 15: Total number of isolates tested (N) and percentage (%) of non-susceptible *Salmonella spp.* in all clinical samples from hospital and community isolates, in Malta, 2009-2021

CIP ciprofloxacin; 3GC* 3rd generation cephalosporin

2.2
Antimicrobial Consumption

Surveillance of antimicrobial use in human health has been long established at both hospital and community care in Malta. Local datasets available by Anatomical Therapeutic Chemical (ATC) Classification System have been collected on an annual basis.

Ambulatory care

A reduction in total antibiotic consumption was evident in 2020 and 2021, coinciding with the COVID-19 pandemic, possibly linked to a drop in medical consultations within ambulatory care. The reduction in use of 2nd generation cephalosporins (especially cefuroxime axetil), previously identified, has continued. However, penicillins with beta-lactamase inhibitors (primarily co-amoxiclav), macrolides (clarithromycin and azithromycin) as well as quinolones (ciprofloxacin and levofloxacin), all highly broad-spectrum formulations, continue to be the predominant classes prescribed in ambulatory care. Indeed, consumption of narrower spectrum formulations (e.g. amoxicillin and 1st generation cephalosporins) remains minimal despite their effectiveness and less resistance inducing properties.

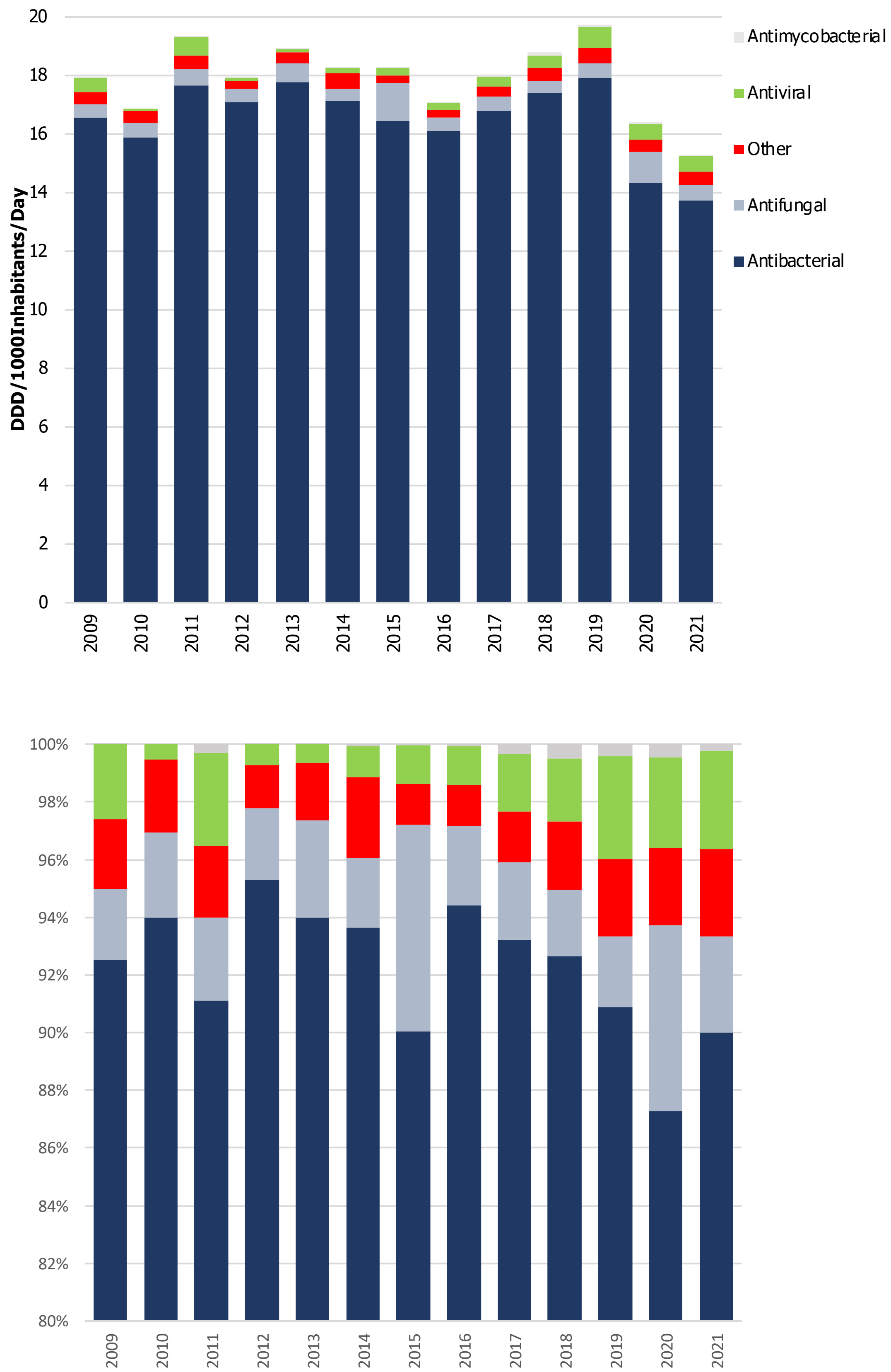


Fig 16: Trends in yearly consumption of anti-infective agents in the community care in Malta, 2009-2021, expressed as (a) total and (b) percent proportion of Daily Defined Dose (DDD) per 1000 inhabitants per day

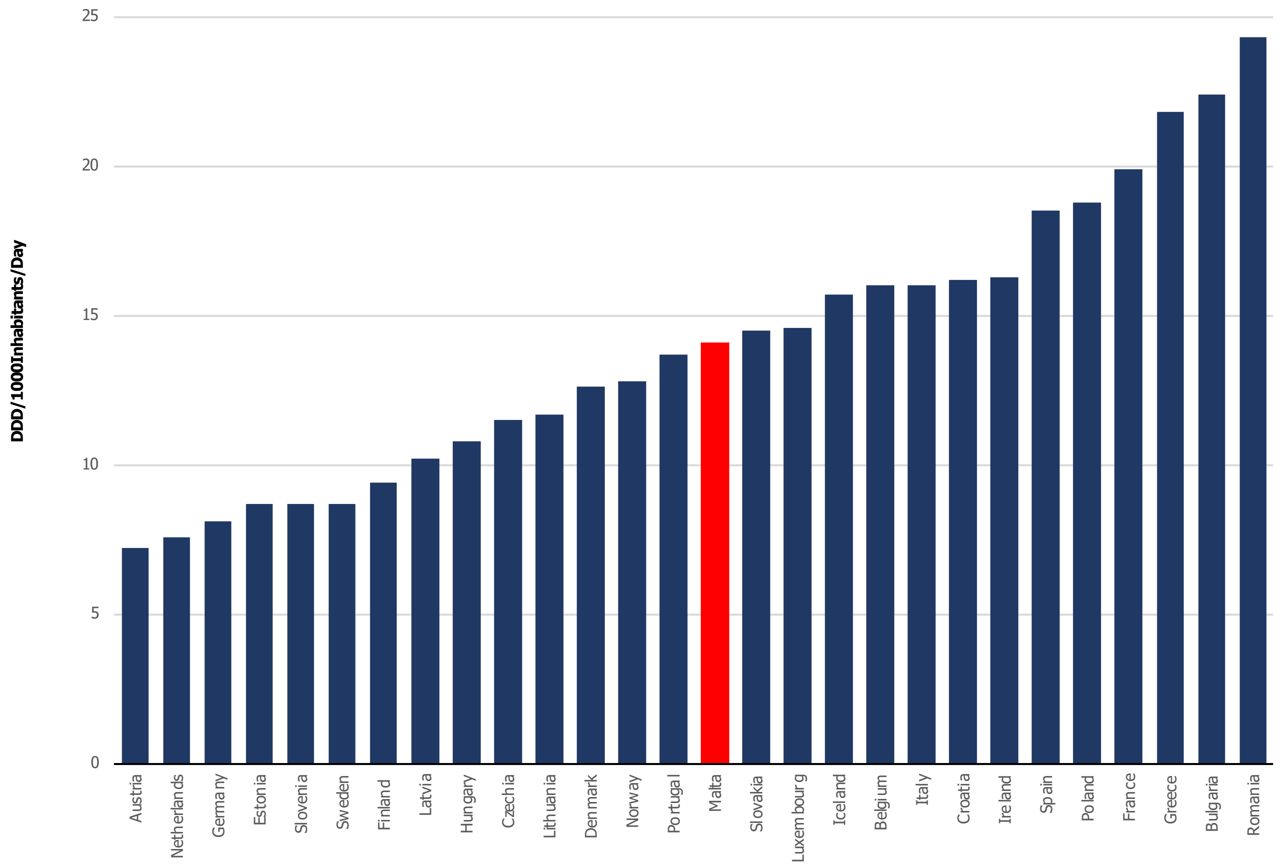


Fig 17: Consumption of antibacterials for systemic use (ATC group J01) in the community in EU/EEA countries, in 2021, expressed as Daily Defined Dose (DDD) per 1000 inhabitants per day (Source: ESAC-Net Annual Epidemiological Report 2021)

United Kingdom and Cyprus did not provide data

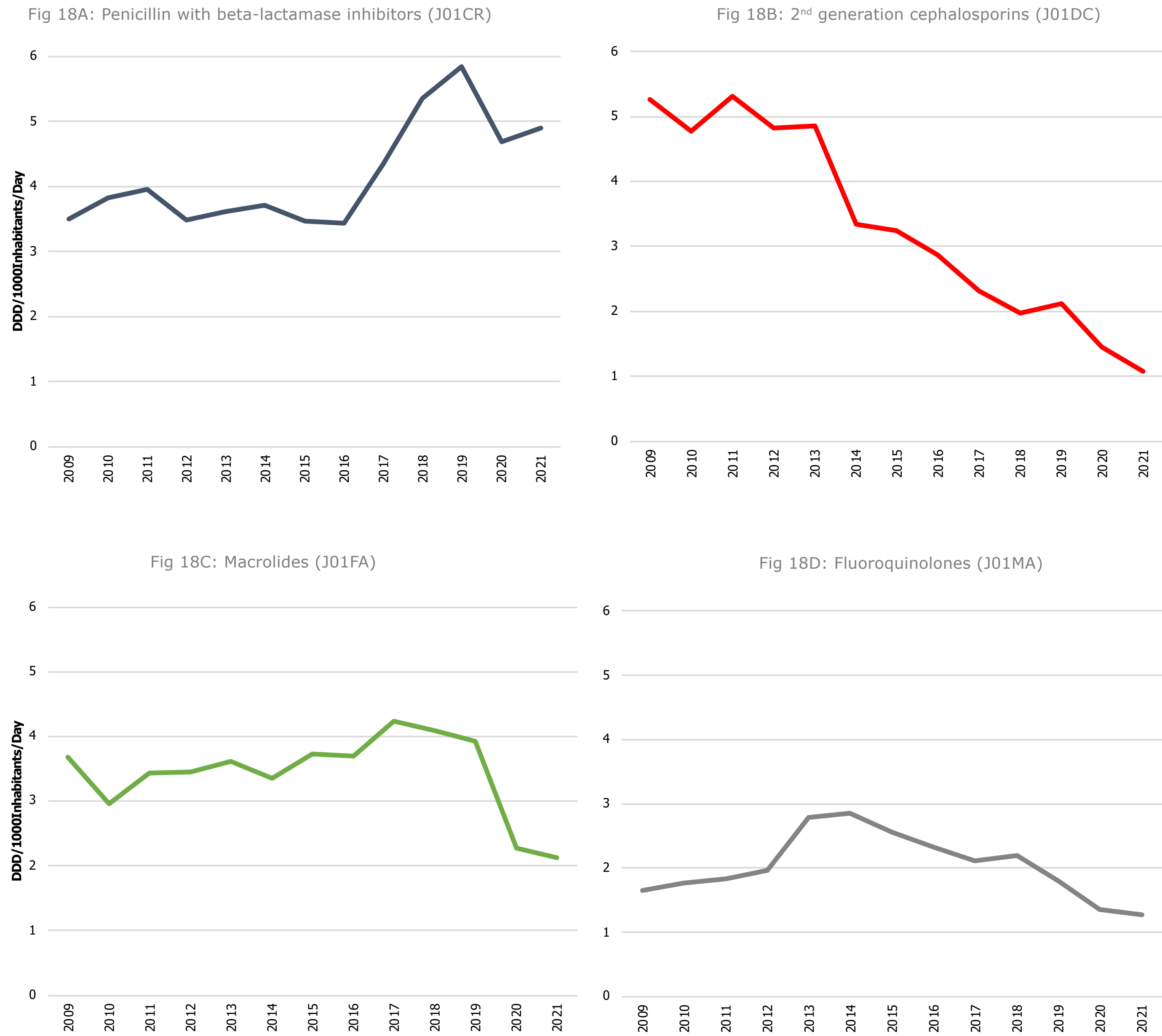


Fig 18: Trends in yearly consumption of selected classes of antibacterial for systemic use (ATC group J01) in the community in Malta, expressed as Daily Defined Dose (DDD) per 1000 inhabitants per day

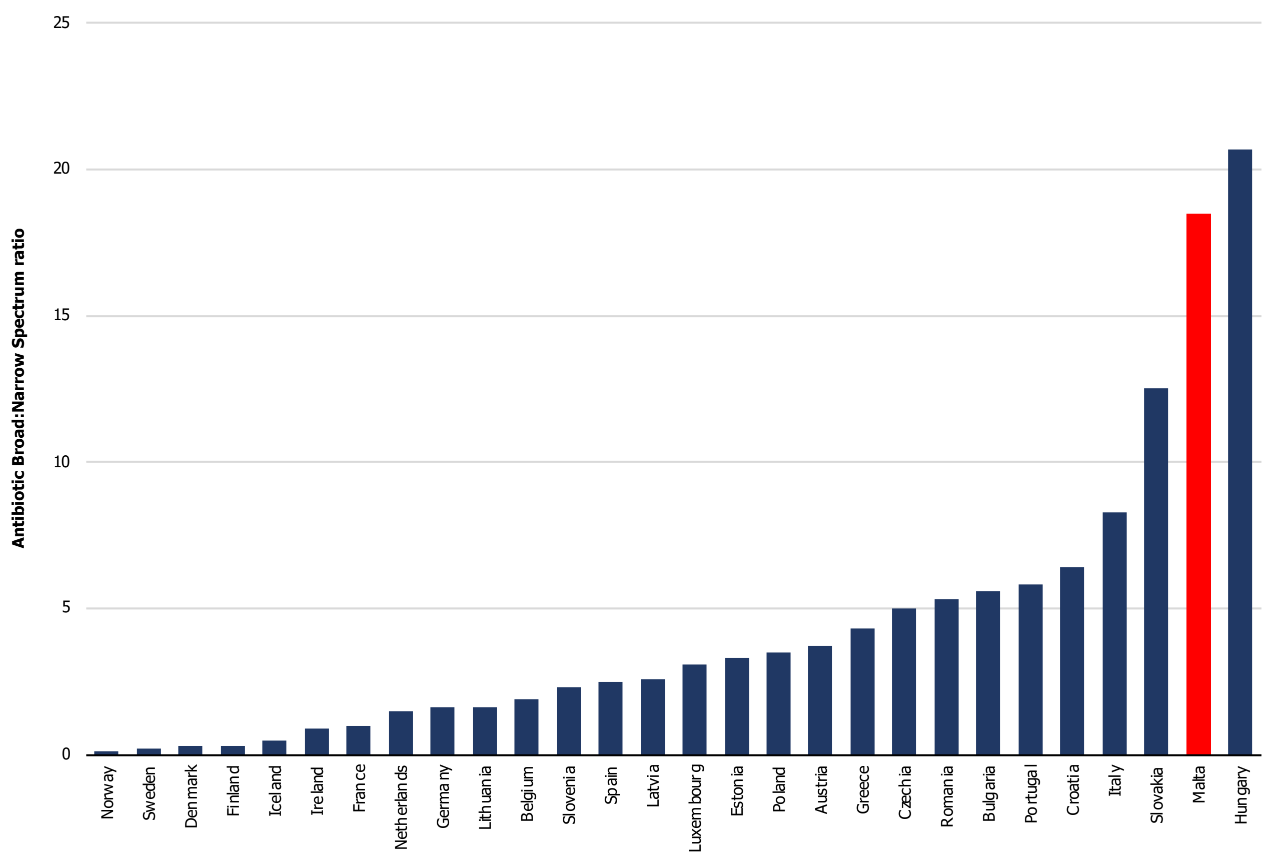


Fig 19: Ratio* of consumption of broad: narrow spectrum vs narrow spectrum antibiotic in EU/EEA countries, in 2021 (Source: ESAC-Net Annual Epidemiological Report 2021)

*Ratio calculated from consumption of broad-spectrum penicillins, cephalosporins and macrolides (except erythromycin) and fluoroquinolones against consumption of narrow-spectrum penicillins, cephalosporins and macrolides (erythromycin) per country

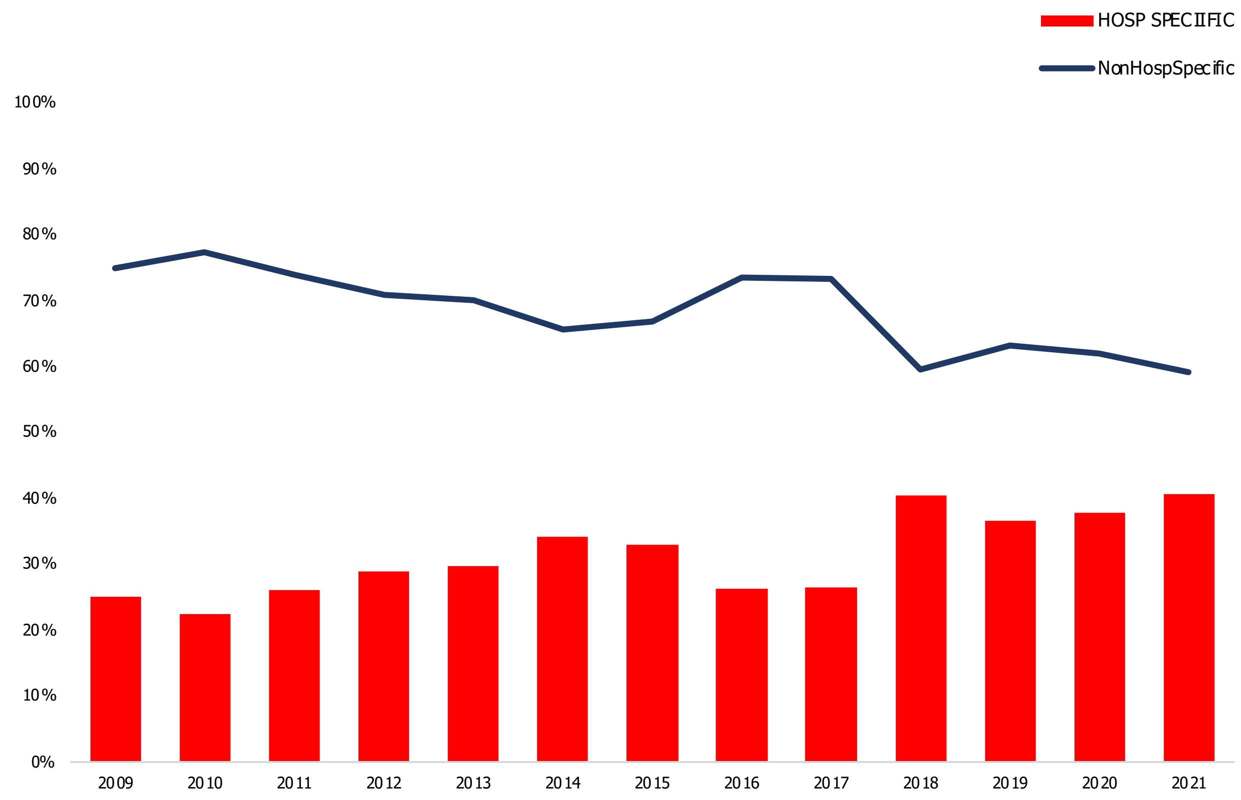


Fig 20: Trends in yearly consumption of antibacterials for systemic use (ATC group J01) for hospital specific and non-hospital specific medicines in Malta, in 2009-2021, expressed as percentage

Hospital care

Trends of consumption of antimicrobials within the hospital setting have stabilised in recent years (Fig 21 and Fig 23). However the "hospital specific" antibiotic groups has shown a consistent increase over past years. Over-use of broad-spectrum antimicrobials (especially carbapenems) still persists within Maltese hospitals. Of particular concern is the very high increase in glycopeptide prescribing (primarily teicoplanin) which has coincided with an equally dramatic increase in VRE prevalence.

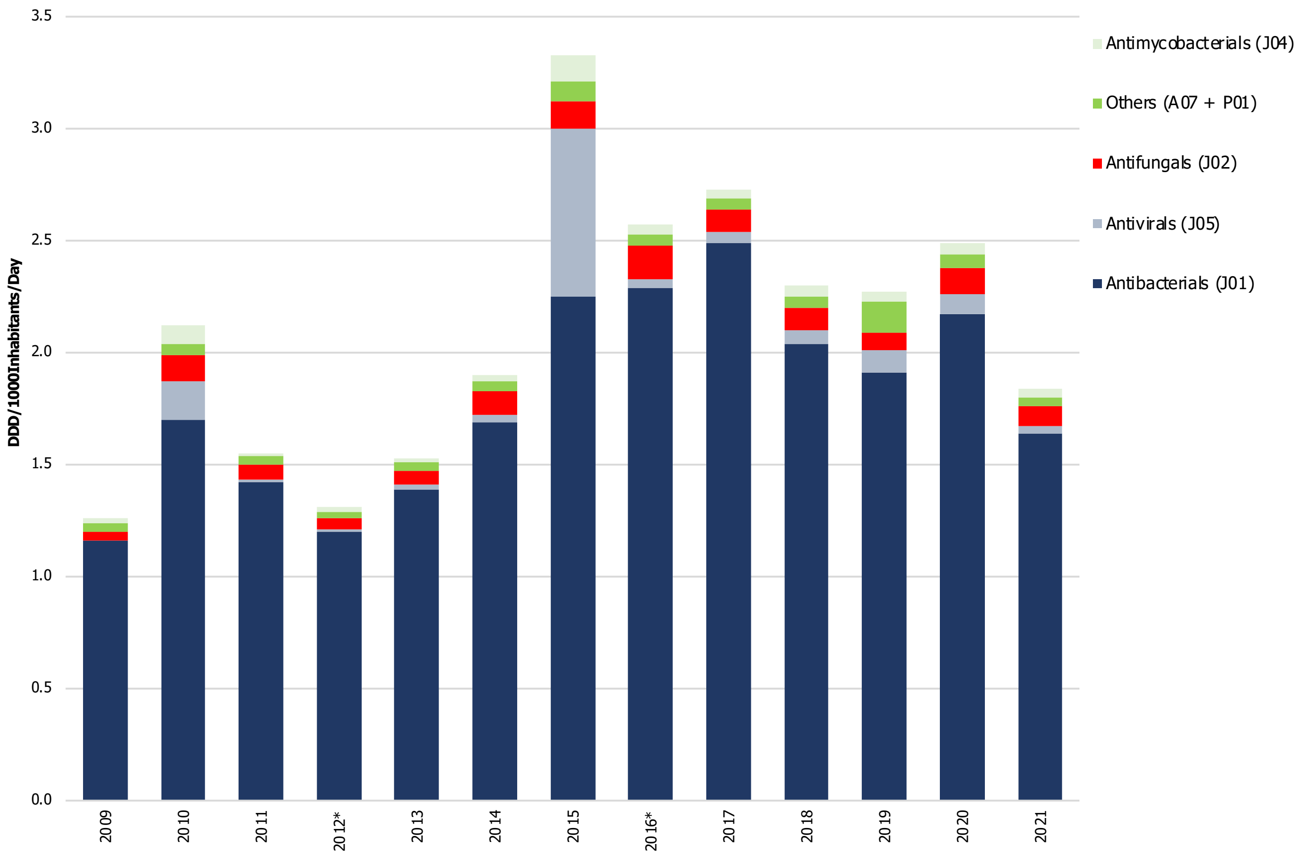


Fig 21: Trends in yearly consumption of anti-infective agents in the hospital care in Malta, in 2021, expressed as Daily Defined Dose (DDD) per 1000 inhabitants per day

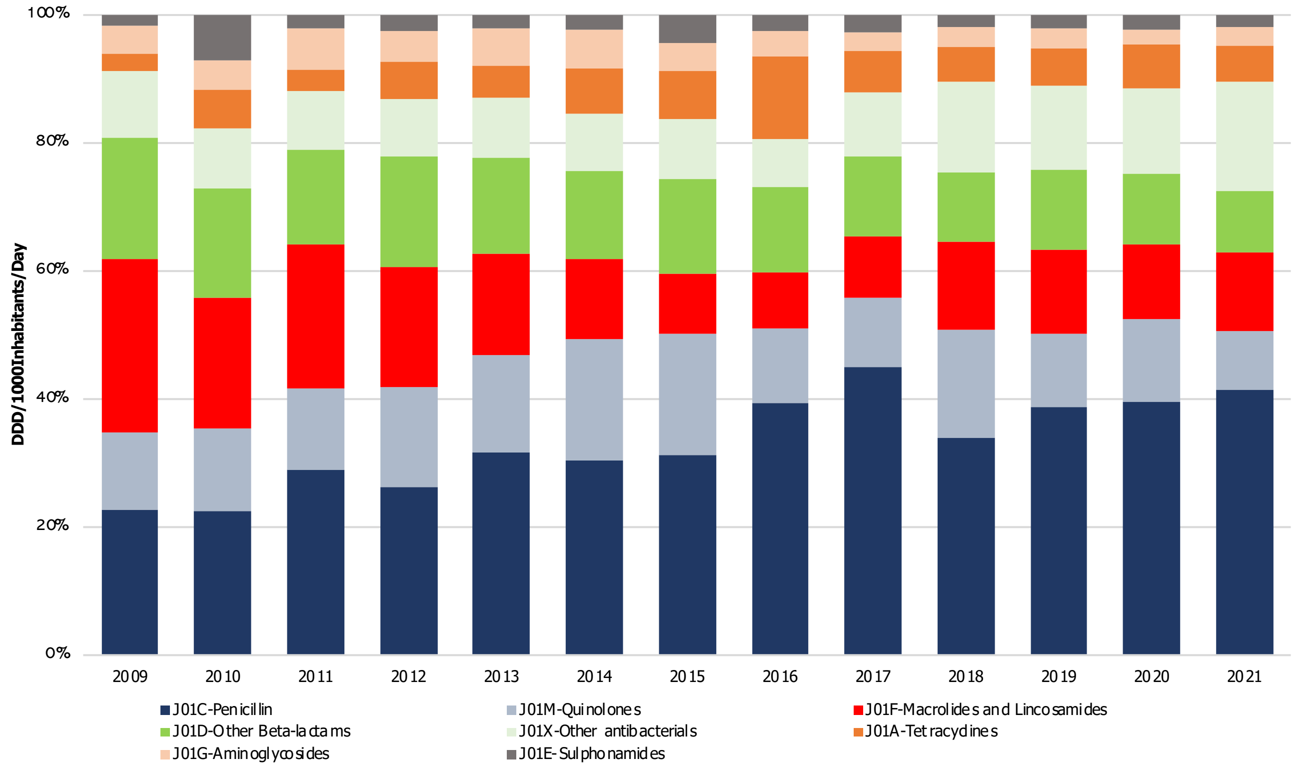


Fig 23: Trends in yearly consumption of antibacterials for systemic use (ATC group J01) in the hospital care in Malta, in 2009-2021, expressed as Daily Defined Dose (DDD) per 1000 inhabitants per day

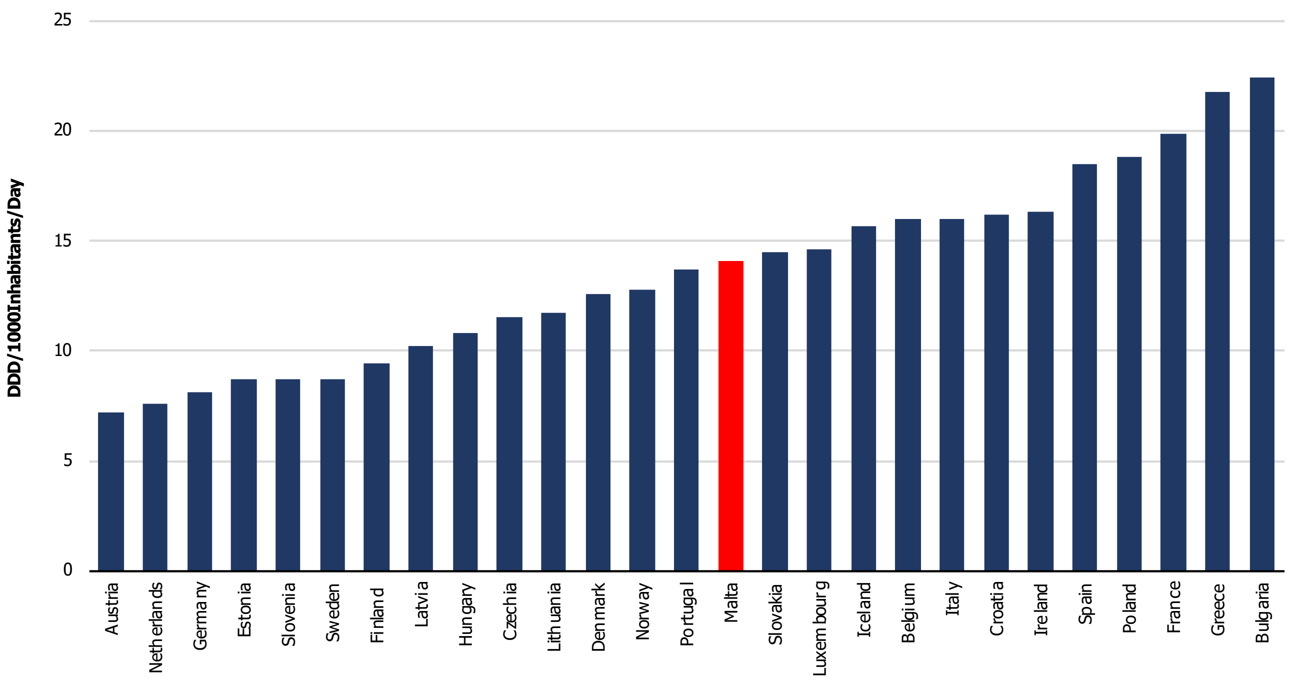


Fig 22: Consumption of antibacterials for systemic use (ATC group J01) in hospital care in EU/EEA countries, in 2021, expressed as Daily Defined Dose (DDD) per 1000 inhabitants per day (Source: ESAC-Net Annual Epidemiological Report 2021)

Cyprus, Germany & United Kingdom did not provide data

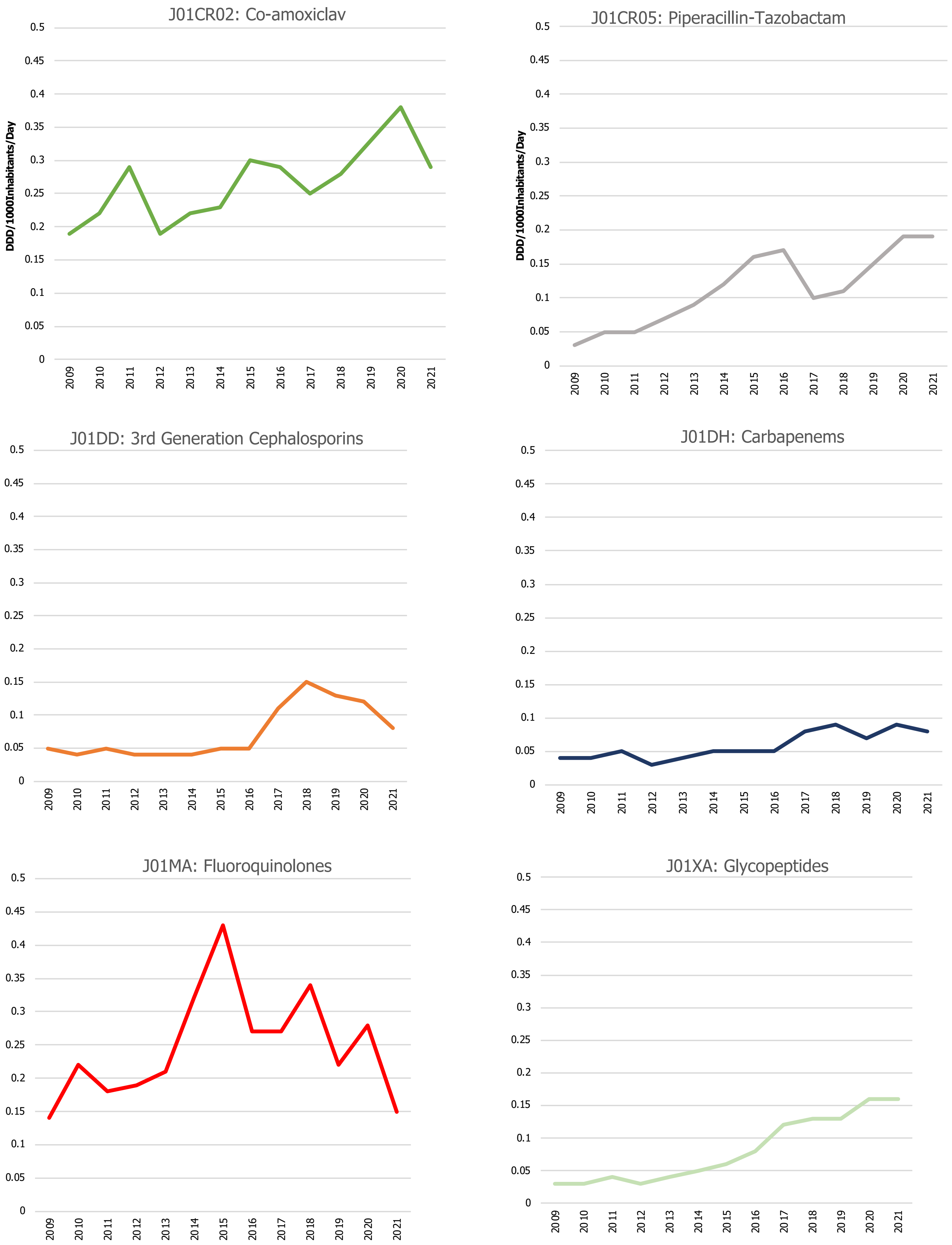


Fig 24: Yearly consumption of selected classes of antibacterials for systemic use (J01) in the hospital care, expressed as Daily Defined Dose (DDD) per 1000 inhabitants per day

WHO Access, Watch, Reserve (AWaRe) classification of antibiotics

The AWaRe classification of antibiotics was developed by WHO in 2017 and groups them into three categories: Access, Watch and Reserve. Appropriate national measures should be taken to ensure that by 2030, at least 65% of the total consumption of antibiotics in human care belongs to the Access group of antibiotics. Over the past five years, the proportion of Access antibiotics has increased to reach 60%.

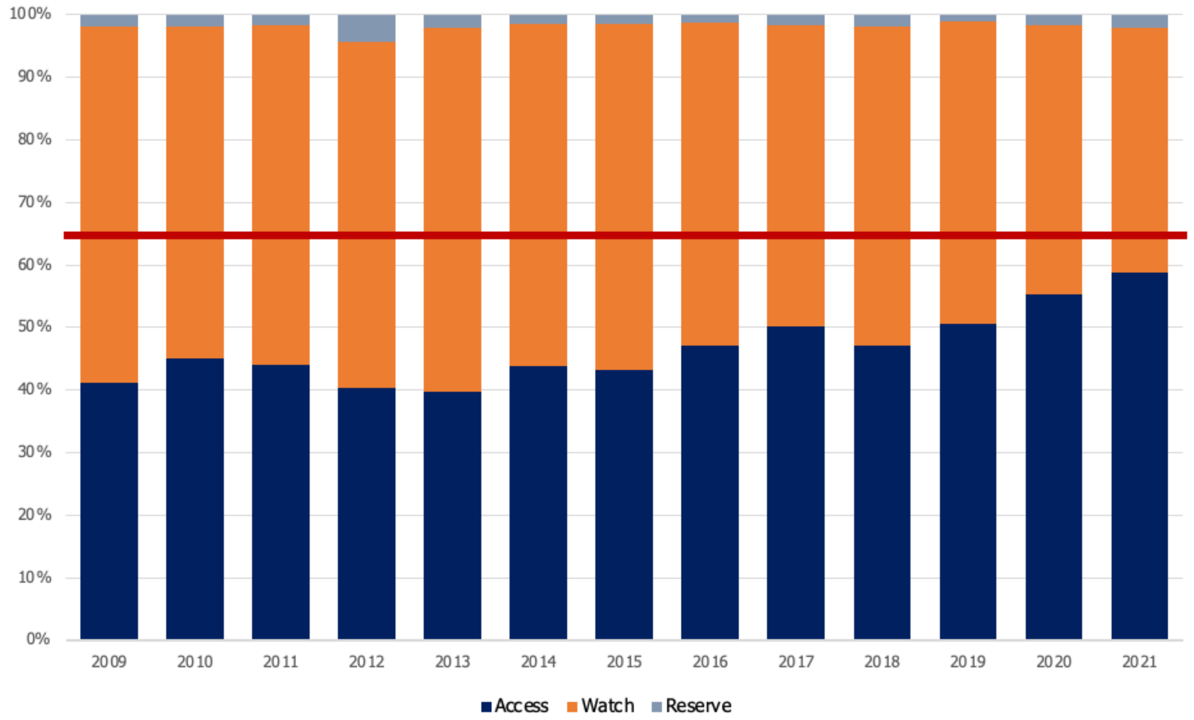


Fig 25: Trends in yearly consumption of antibacterials in the community and hospital care in Malta, in 2009-2021, expressed in accordance to AWaRe classification of antibiotics

Animal Health

3.1 AMR Epidemiology

The National Veterinary Laboratory (NVL) has been chosen as one of the designated laboratories for analysing samples for the Monitoring of AMR in Zoonotic and Commensal Bacteria by the Competent Authority since 2014. Analysis is performed on samples for the isolation of *Salmonella* spp., commensal indicator *Escherichia coli*, ESBL-, AmpC- or Carbapenemase-producing *Escherichia coli* and Campylobacter. A study will be carried out on MRSA in 2025.

Isolation of ESBL-, AmpC- or Carbapenemase-producing Escherichia coli from caecal samples

A total of 128 caecal samples were taken from the two swine slaughterhouse in Malta and Gozo in 2019. The NVL isolated 34 isolates which were presumptive ESBL-, AmpC- and Carbapenemase- producing *Escherichia coli*. This has resulted in a total of 26.6% positivity rate. The quarterly distribution of the samples according to the slaughterhouses was the same and the number of positive and negative samples can be seen in Fig 26.

During the last quarter of 2021, 36 samples were analysed for the presence of presumptive carbapenemase-producing *Escherichia coli*. The isolates obtained were analysed for Antimicrobial Susceptibility Testing using microbroth dilution method within the ranges stipulated in the revised Commission Implementing Decision of 2020/1729. None of the samples analysed for the presence of carbapenemase-producing *Escherichia coli* resulted positive. Thus a 100% negativity rate was obtained from these samples.

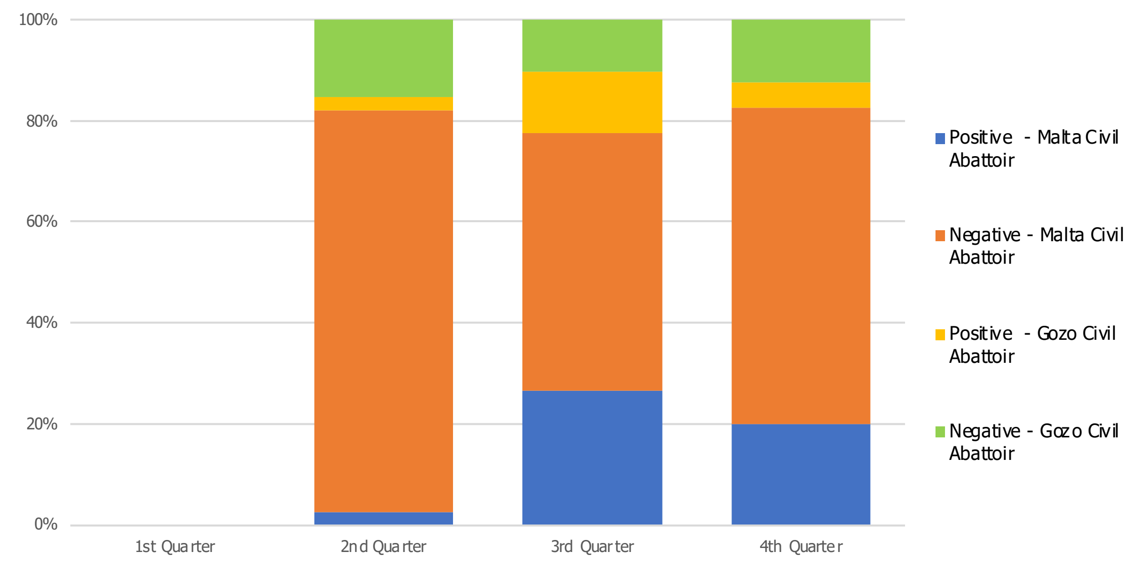


Fig 26: Quarterly distribution of positive and negative samples for the isolation of presumptive ESBL-/AmpC- producing *Escherichia coli* from Malta and Gozo Civil Abattoirs

AMR in Salmonella spp. cultures

During the 2021 AMR Programme, 59 isolates were obtained and tested for AMR. Out of these, 37 isolates (62.71%) resulted to be susceptible to all of the antimicrobials against which they were tested for. Eleven isolates (18.64%) were resistant to one antimicrobial. Five isolates (8.47%) were resistant to two antimicrobials while another five isolates (8.47%) were resistant to three antimicrobials. The most resistant isolate (1.69%) was resistant to four antimicrobials. All *Salmonella* isolates were tested against 15 different antimicrobials as per Table II of the Annex of Commission Implementing Decision 2020/1729. None of the isolates required further testing and thus none of the isolates were presumptive ESBL-, AmpC- or carbapenemase- producing strains.

Trends of AMR in Salmonella spp. isolates

Throughout the last six years, *Salmonella spp*. have been analysed three times from swine caecal samples collected from the slaughterhouses in Malta and Gozo. Fig 27 shows the percentage of *Salmonella* isolates resistant to each of the antimicrobials against which they were tested. This trend shows that the amount of isolates resistance to sulfamethoxazole have dropped significantly between 2017 and 2021. Another decrease can be noticed between 2017 and 2021 for tetracycline resistance. In 2017 there were 41.18% resistant isolates while in 2019 this decreased to 20%. From 2019 to 2021 there was an increase of 3.73% resistance to a total of 23.73%. Although there was a small drop in the resistance of ampicillin from 2017 to 2019, the resistance increased by double from 2019 to 2021. In fact the resistance in 2021 was even higher than 2017.

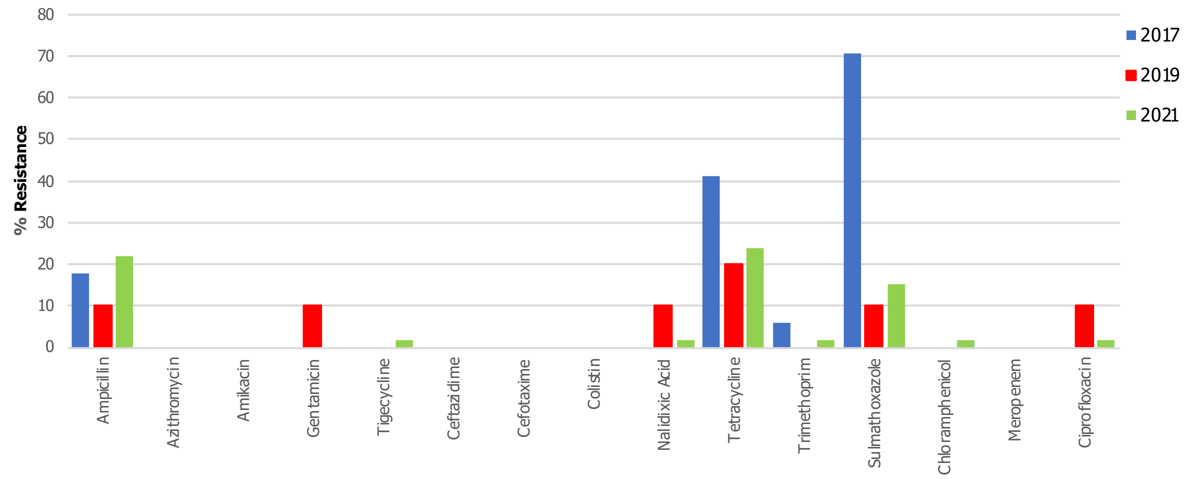


Fig 27: Percentage resistance of Salmonella isolates in 2017, 2019 and 2021

AMR in commensal indicator *Escherichia coli*

In 2021, the NVL analysed 126 commensal indicator *Escherichia coli* isolates for AMR. The most common resistance was for tetracycline (75 resistant isolates [59.52%]), followed by sulfamethoxazole (57 resistant isolates [45.24%]) and trimethoprim (49 resistant isolates [38.89%]). None of the commensal indicator *Escherichia coli* isolates needed further testing under Table V of the Annex, of Commission Implementing Decision 2020/1729. Thus, none of isolates had an ESBL-/AmpC- or Carbapenemase-producing phenotype. Table 1 shows the proportion of isolates which were resistant for each antimicrobial.

Table 1: Proportion of isolates resistant to each antibiotic and their respective percentage

	RESISTANT ISOLATES	% RESISTANCE
Ampicillin	38	30.16%
Azithromycin	0	0%
Amikacin	0	0%
Gentamicin	3	2.38%
Tigecycline	0	0%
Ceftazidime	0	0%
Cefotaxime	0	0%
Colistin	0	0%
Nalidixic Acid	7	5.55%
Tetracycline	75	59.52%
Trimethoprim	49	38.89%
Sulfamethoxazole	57	45.24%
Chloramphenicol	26	20.64%
Meropenem	0	0%
Ciprofloxacin	14	11.11%

Trends of AMR in commensal indicator *Escherichia coli*

The AMR monitoring programme on commensal indicator *Escherichia coli* showed that the antimicrobial resistance has increased between 2017 and 2019. During these years there were increases in resistance to chloramphenicol and ciprofloxacin. The most significant trend decrease in resistance over the four years was in sulfamethoxazole (Fig 28).

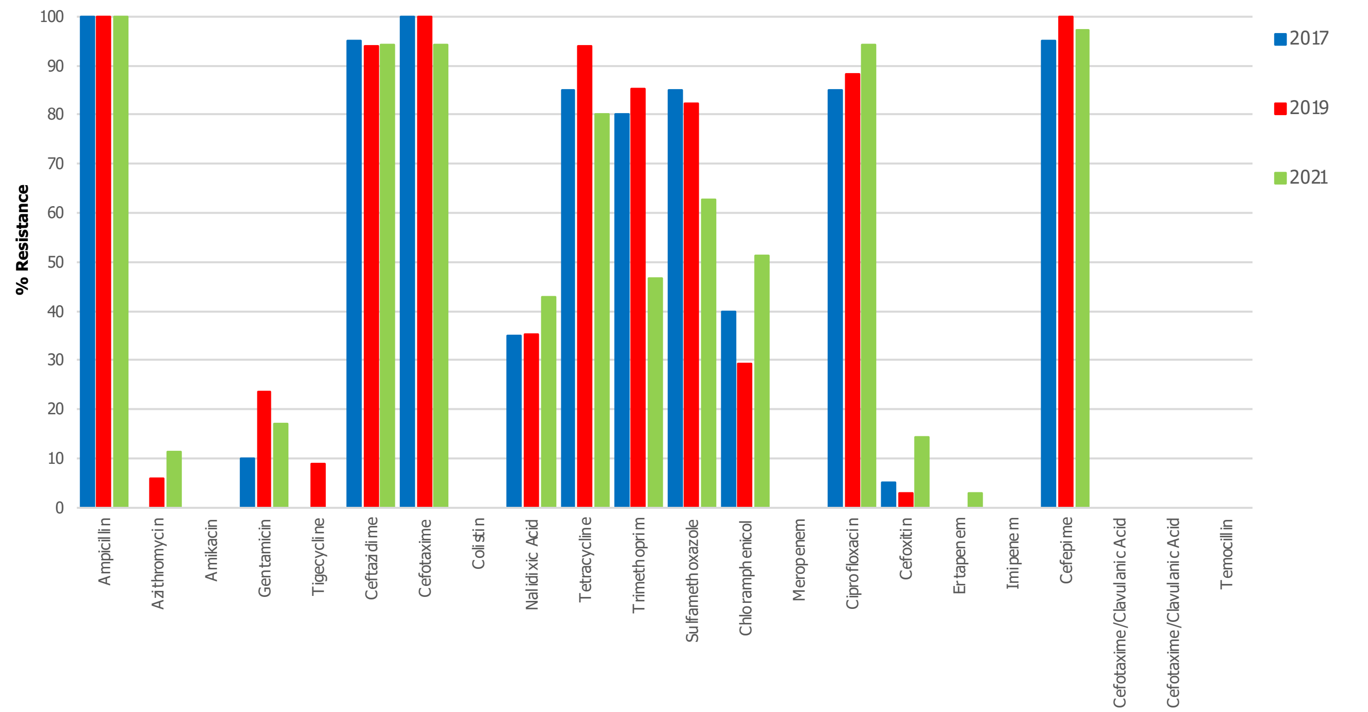


Fig. 28: Percentage resistance of presumptive ESBL-/AmpC-producing *Escherichia coli* in 2017, 2019 and 2021

AMR in presumptive ESBL-/AmpC- Escherichia coli

The NVL analysed 35 isolated which were presumptive ESBL-/AmpC- producing *E. coli*. Fig 29 shows the distribution of ESBL-/AmpC- isolates obtained throughout Malta and Gozo Civil Abattoirs. From the swine slaughtered at Malta Civil Abattoir, 21 isolates were ESBL- phenotype, with a prevalence of 85.77% from the isolates obtained from the Malta Civil Abattoir and 60% of all isolates obtained throughout Malta and Gozo Civil Abattoirs. From the isolates obtained from the swine slaughtered in Gozo, the ESBL- phenotype was the most commonly identified; with 88.89% prevalence from its respective slaughterhouse and 22.86% of isolates obtained from both Malta and Gozo.

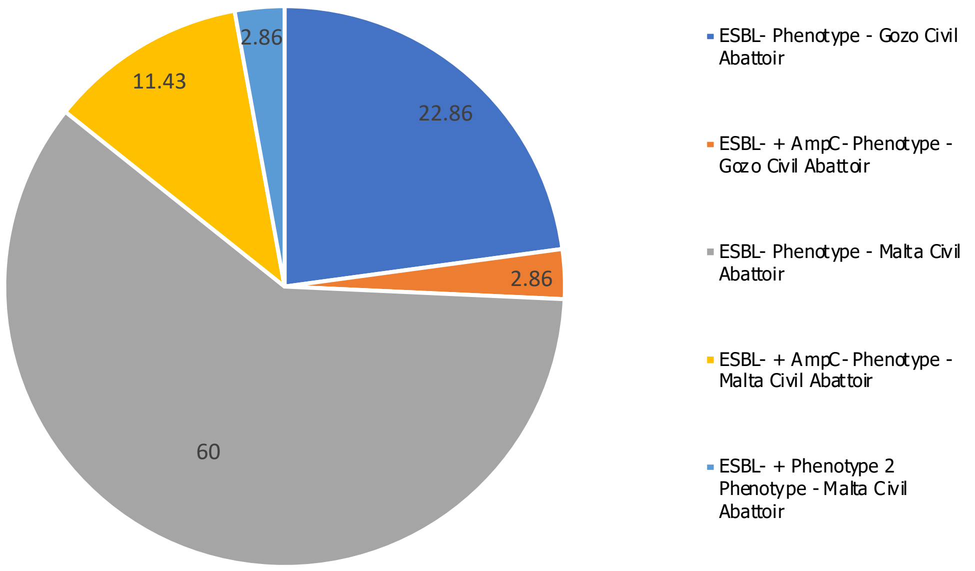


Fig 29: Distribution of ESBL-/AmpC- phenotypes in Presumptive ESBL-/AmpC- isolates in 2021

AMR obtained within each phenotype of Escherichia coli

All the isolates were grouped according to their phenotype and the collection location. Fig 30 shows the percentage of ESBL- producing *Escherichia coli* isolates resistant for each antimicrobial during 2021. It can be noticed that within the ESBL- phenotype, azithromycin and ertapenem resistance was only obtained from isolates originating from swine slaughtered at the Gozo Civil Abattoir. On the other hand, resistance for gentamicin was only obtained in some isolates obtained from swine slaughtered at the Malta Civil Abattoir. Resistance for ampicillin, ceftazidime, cefotaxime ciprofloxacin, cefepime, nalidixic acid, tetracycline, trimethoprim, sulfamethoxazole and chloramphenicol was roughly the same for cultures obtain from both slaughterhouses. However resistance for tetracycline and trimethoprim were slightly higher in Malta Civil Abattoir.

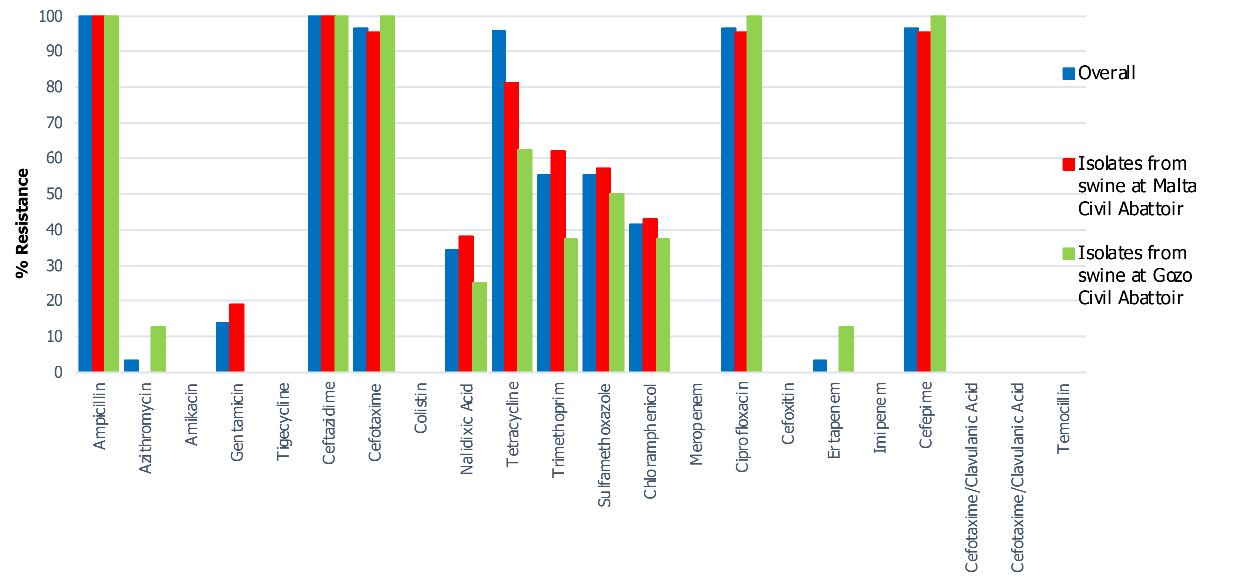


Fig 30: Percentage resistance of ESBL- producing *Escherichia coli* to each antimicrobial in 2021

The resistance of ESBL- +/AmpC- phenotype cultures were also analysed as shown in Fig 31. The resistance within this group was very similar between all the cultures obtained. All of the cultures were resistant to ampicillin, ceftazidime, cefotaxime, nalidixic acid, tetracycline, trimethoprim, sulfamethoxazole, chloramphenicol, ciprofloxacin, cefoxitin and cefepime. The only differences were for azithromycin and gentamicin. Sixty percent of the cultures obtained from swine at Malta Civil Abattoir were resistant to azithromycin, while all the isolates obtained from the swine in Gozo Civil Abattoir were susceptible. Half of the cultures obtained from swine at Malta Civil Abattoir were resistant to gentamicin but none of the isolates of Gozo Civil abattoir were resistant.

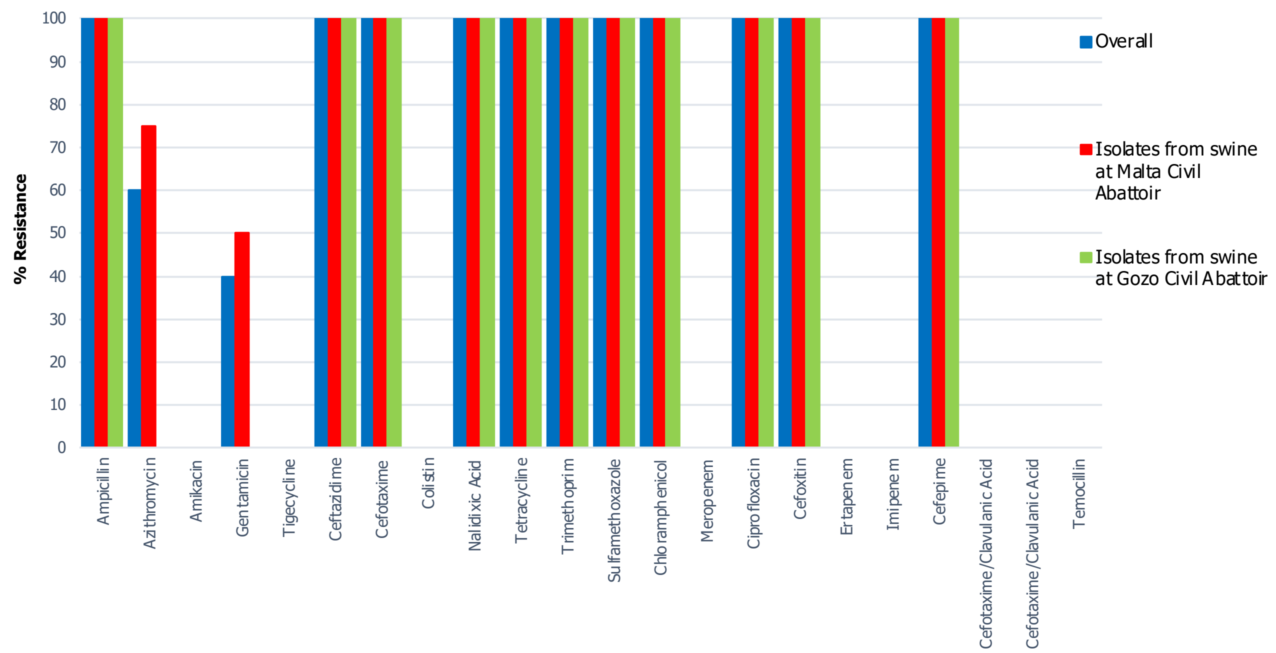


Fig 31: Percentage resistance of ESBL- +/AmpC- producing *Escherichia coli* to each antimicrobial

Trends of AMR in presumptive ESBL-/AmpC- producing Escherichia coli

The percentage resistance of all ESBL-/AmpC- isolates obtained in 2017, 2019 and 2021 were analysed. There were some small changes in the resistance of certain antibiotics but the change was insignificant. The most common resistance was in cefotaxime, ceftazidime, ampicillin and cefepime. Although there was very little difference in the resistance of the isolates, it was noted that the amount of presumptive ESBL-/AmpC- phenotypes have drastically increased from 17.8% to 47.2% between 2017 and 2019. However, the amount started to decrease again in 2021, having a prevalence of 27.34%. Fig 32 shows the prevalence of presumptive ESBL-/AmpC- producing *Escherichia coli* in 2017, 2019 and 2021.

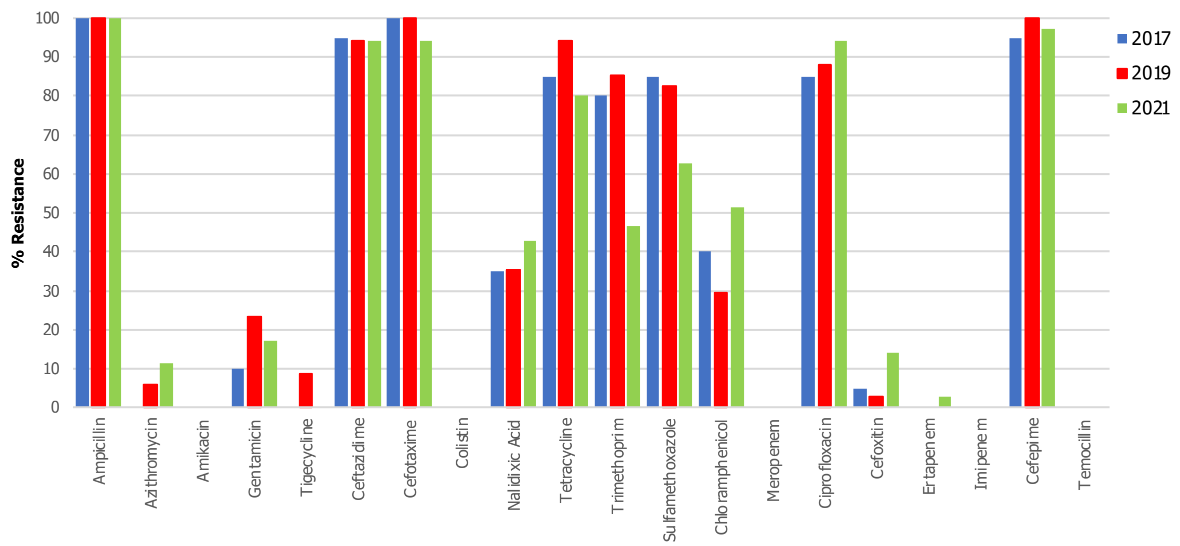


Fig. 32: Percentage resistance of presumptive ESBL-/AmpC-producing *Escherichia coli* in 2017, 2019, 2021

The number of resistant *Salmonella spp.* isolates from swine carcasses are showing a downward trend throughout the years. The number of resistant commensal indicator *Escherichia coli* decreased when compared to 2019 but there is still a marked increase when compared to 2017. The resistance in commensal indicator *Escherichia coli* is high for tetracycline, trimethoprim and sulphamethoxazole. The AMR profile of presumptive ESBL-/AmpC- producing *Escherichia coli* isolates appears to be stable over the years. Carbapenemase-producing *Escherichia coli* have never been isolated from swine samples.

Trends of AMR on Salmonella spp. strains isolated from poultry

The AMR monitoring programme for the years 2020 and 2022 targeted poultry species. In 2020, due to the COVID-19 pandemic and other circumstances, the analysis focused on *Salmonella spp.* isolates arising from the *Salmonella* National Control Programme. Table 2 shows data relevant to susceptible and resistant *Salmonella spp.* isolates under the *Salmonella* National Control Programme of 2020 and 2022. In 2020, 48 S*almonella spp.* strains were analysed for AMR whilst in 2022, 41 strains were tested. In 2020, 37.5% (18 strains) were susceptible to all antibiotics whilst in 2022 susceptible strains increased to 70.7% (29 strains).

Table 2: Summary of all the isolates tested for AMR in 2020 and 2022

2020 SUSCEPTIBLE	2022 SUSCEPTIBLE	2020 RESISTANT	2022 RESISTANT
S. croft – 1	*S. livingstone* – 3	*S. kentucky* – 16	*Monophasic Typhimurium* – 3
S. kedougou – 2	*S. haifa* – 5	*S. infantis* – 4	*S. kentucky* – 9
S. enteritidis – 2	*S. typhimurium* – 1	*Monophasic Typhimurium* – 3	
S. give – 2	*S. give* – 2	*S. haifa* – 7	
S. haifa – 4	*S. derby* – 1		
S. kentucky - 7	*S. enteritidis* – 2		
	S. infantis – 3		
	S. isangi – 1		
	S. croft – 2		
	S. corvallis – 1		
	S. kentucky – 8		

3.2
Antimicrobial Consumption

The sales of antimicrobial veterinary medicinal products (VMPs) in Malta, expressed as mg sold per Population Correction Unit (PCU), was 110.5mg/PCU for 2021 (Fig 33). The EU average, as reported by the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) Report in 2021, was 47.6mg/PCU with a range from 2.5 mg/PCU to 296.5 mg/PCU across the 31 countries (Fig 34).

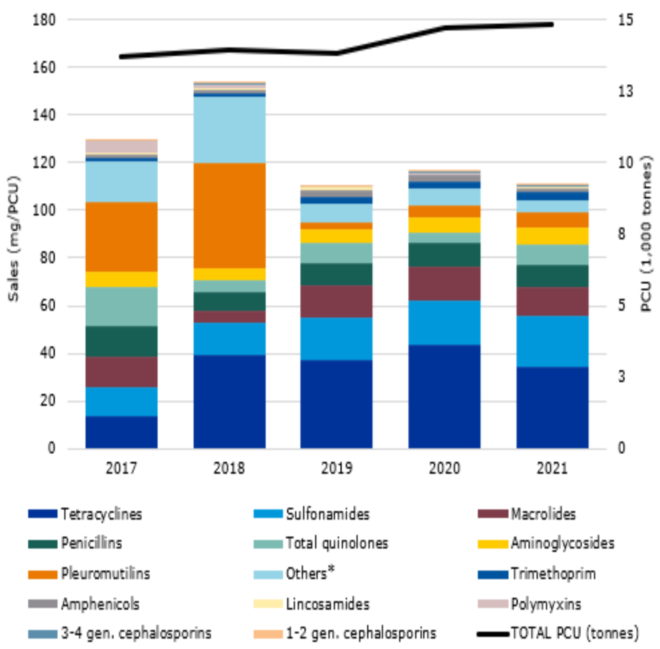


Fig 33: Sales for food-producing animals, in mg per Population Correction Unit (mg/PCU) of various veterinary antimicrobial classes, from 2017–2021
*bacitracin, fosfomycin, furaltadone, metronidazole, novobiocin, paromomycin, rifaximin and spectinomycin

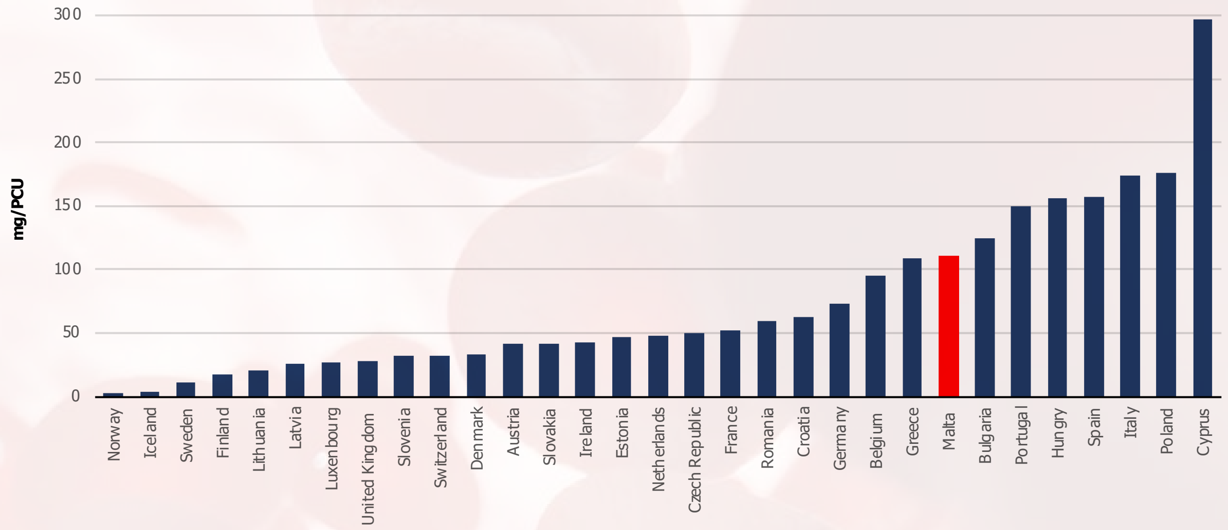


Fig 34: Total sales for food-producing animals, in mg per population correction unit (mg/PCU) of the various veterinary antimicrobial classes for European countries, 2021

Since 2017 the overall sales have reduced by 14.5%, marking a decrease of 93.4% in polymyxins, 47.9% in quinolones and 44.10% in fluoroquinolones sales. An increase of 9.1% was seen in 3rd and 4th generation cephalosporins sales. The majority of antibiotic VMPs sales in 2021 belonged to the Antimicrobial Advice Ad Hoc Expert Group (AMEG) category D (Prudence), accounting for 66.7% of the total sales (Fig 35). In 2021, the overall sales decreased 4.9% in comparison to 2020 (from 116.1 mg/PCU to 110.5 mg/PCU). The three highest-selling antibiotic classes were tetracyclines, sulphonamides and macrolides, which accounted for 31.2%, 19.4% and 10.7% of total sales, respectively.

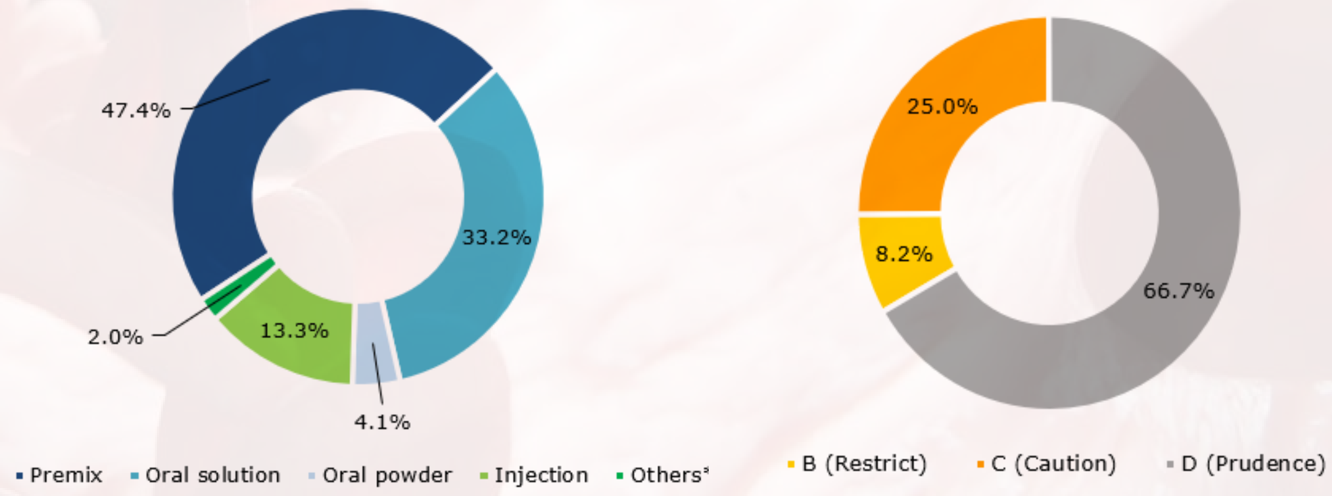


Fig 35: Proportion of sales (mg/PCU) by a) product form and b) the Antimicrobial Advice Ad Hoc Expert Group (AMEG) categories in 2021

Environmental Health

4.1
AMR in food production

A substantial number of *E. coli* isolated from meat samples taken from retail establishments tested positive for ESBL. This was especially the case for poultry at more than 40% in chickens and 25% in turkeys.

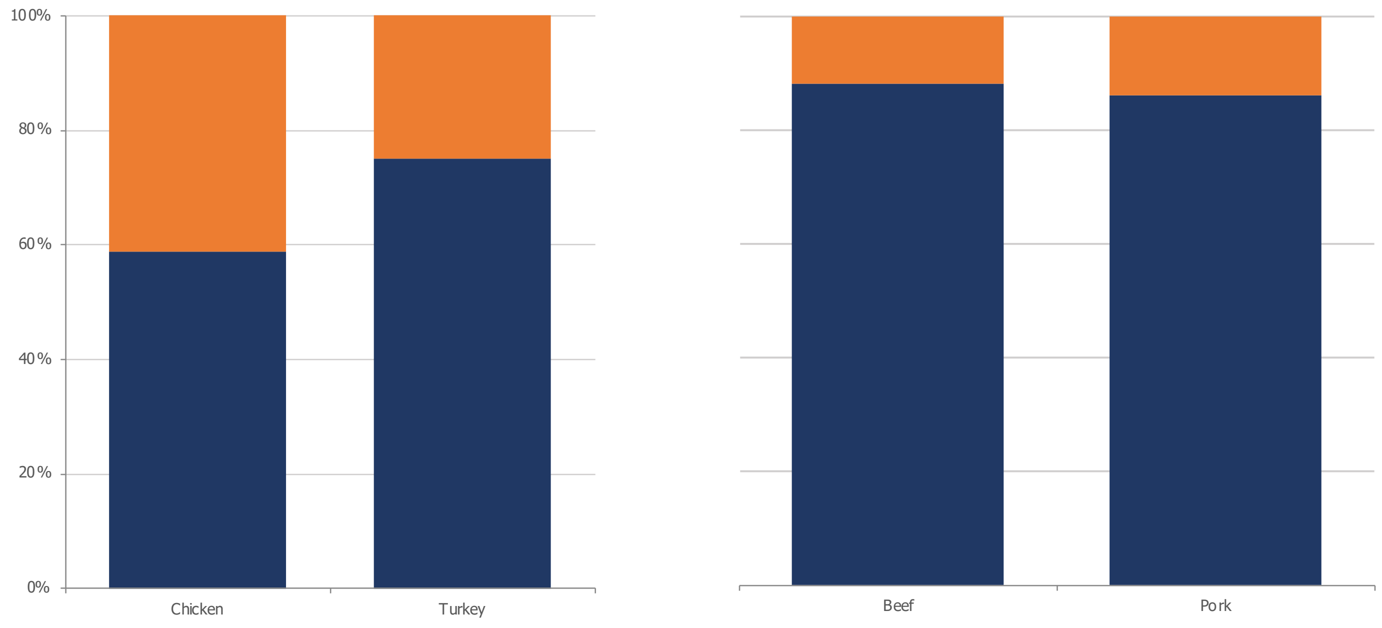


Fig 36: Proportion (in percentage) of ESBL- *Escherichia coli* isolated from samples submitted to Public Health Laboratory from retail outlets of a) chicken (n=138) and turkey (n=12) in Malta, 2020 b) beef (n=150) and pork (n=150) in Malta, 2021

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Committee
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