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Attributable deaths and disability-adjusted life-years (DALYs) caused by infections with antibiotic-resistant bacteria in Switzerland from 2010 to 2019

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BACKGROUND / AIM

Cassini et al. (1) estimated around 33'000 deaths and 875'000 DALYs resulting from infections with 16 antibiotic resistance-bacterium combinations in the EU or European Economic Area (EEA) in 2015. Using the same approach on a national level Gasser et al. (2) estimated approximately 280 attributable deaths and 7400 DALYs for Switzerland in 2015. In this current study we aim to describe the development of these indicators over a period of 10 years (2010-2019).

An additional aim is to examine how the population coverage within one country affects the burden of disease model output.

MATERIAL & METHODS

Yearly data on bloodstream infections were prospectively collected within the Swiss national antibiotic resistance database ANRESIS. Attributable deaths, DALYs and infections were estimated from this dataset according to Cassini et al. (1) using the Burden of Communicable Disease in Europe toolkit (3). In each run 10'000 Monte Carlo simulations were performed.

For the main analysis we extrapolated our data to the Swiss population using yearly coverage rates (which increased from 52% in 2010 to 89% in 2019).

In an additional analysis we restricted the dataset (and the extrapolation) to hospitals participating in ANRESIS during the whole study period.

RESULTS

From 2010 to 2019 annually estimated attributable deaths increased from 176 (95%UI: 169-184) to 288 (95%UI: 271-305) (+64% increase), DALYs from 5370 (95%UI: 5157-5594) to 7064 (95%UI: 6751-7386) (+32% increase) and infections from 4137 (95%UI: 3990-4287) to 7382 (95%UI: 7009-7755) (+78% increase). Corresponding numbers per 100'000 population were 2.24 (2010, 95%UI: 2.14-2.34) to 3.34 (2019, 95%UI: 3.15-3.54) attributable deaths, 68.2 (2010, 95%UI: 65.5-71.1) to 82.1 (2019, 95%UI: 78.4-85.8) DALYs and 52.6 (2010, 95%UI: 50.7-54.5) to 85.8 (2019, 95%UI: 81.4-90.1) infections. Throughout the whole study period most deaths and DALYs were attributed to third-generation cephalosporin-resistant *Escherichia coli* (Figure 1). In the first two years these were followed by methicillin-resistant *Staphylococcus aureus* thereafter by carbapenem-resistant *Pseudomonas aeruginosa*.

RESULTS

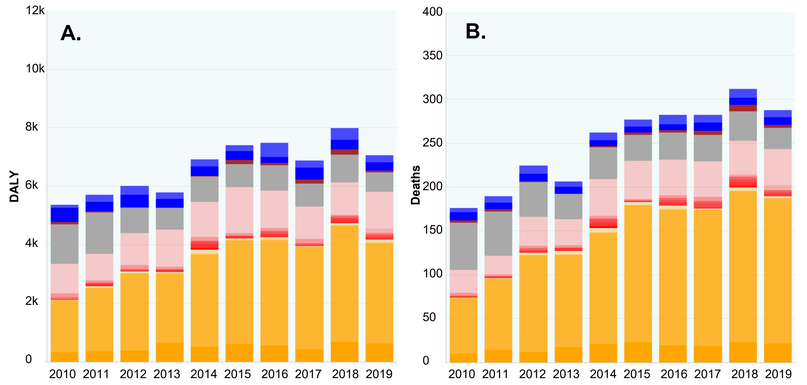

Figure 1: Estimated number of DALYs (A.) and deaths (B.) in Switzerland 2010-2019 attributable to a selection of antibiotic-resistant bacteria. Endpoints were estimated with the population coverage of each year. Color codes: Penicillin-resistant and macrolide-resistant *Streptococcus pneumoniae*. Penicillin-resistant *S pneumoniae*. Vancomycin-resistant *Enterococcus faecalis* and *Enterococcus faecium*. Meticillin-resistant *Staphylococcus aureus*. Carbapenem-resistant *Pseudomonas aeruginosa*. Colistin-resistant *P aeruginosa*. Carbapenem-resistant *Acinetobacter* spp. Colistin-resistant *Acinetobacter* spp. Carbapenem-resistant *Escherichia coli*. Colistin-resistant *E coli*. Carbapenem-resistant *Klebsiella pneumoniae*. Colistin-resistant *K pneumoniae*. Multidrug-resistant *P aeruginosa*. Multidrug-resistant *Acinetobacter* spp. Third-generation cephalosporin-resistant *E coli*. Third-generation cephalosporin-resistant *K pneumoniae*.

An interactive representation of these analyses can be found on https://tinyurl.com/ANRESIS

In an additional analysis using the population coverage of 2010 for all simulations from 2010 to 2019 (Figure 2) annually estimated attributable deaths increased from 176 (95%UI: 169-184) to 344 (95%UI: 364-385) (+ 95% increase), DALYs from 5370 (95%UI: 5157-5594) to 9161 (95%UI: 8744-9584) (+ 71% increase) and infections from 4137 (95%UI: 3990-4287) to 9315 (95%UI: 8858-9755) (+ 125% increase).

RESULTS

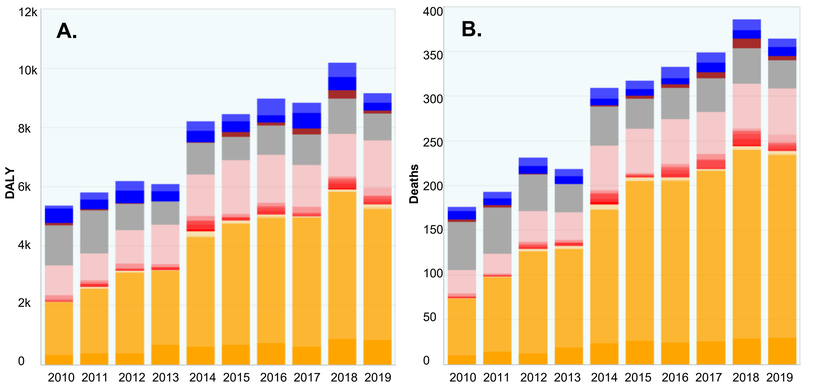

Figure 2: Estimated number of DALYs (A.) and deaths (B.) in Switzerland 2010-2019 attributable to a selection of antibiotic-resistant bacteria. Endpoints of every year were estimated in this model with the population coverage of 2010. Color codes are identical to Figure 1.

CONCLUSIONS

This first continuous surveillance of estimated deaths and DALYs caused by infections with a selection of antibiotic-resistant bacteria in Switzerland shows that estimated parameters are still on a low to intermediate level compared to other European countries (EU/EAA medians 2015: 6.44 deaths and 170 DALYs per 100'000 population). However, considerable increases of deaths and DALYs between 2010 and 2019 indicate a nationwide aggravation of the epidemiological situation.

In an additional analysis it was shown that estimations of different endpoints were higher when a low population coverage was used compared to estimations with a higher coverage. This finding indicates an overestimation in the low coverage setting probably due to more severe cases in larger hospitals, which were providing relatively more data in the early years of the study.

REFERENCES

1. Cassini, A. et al., The Lancet Infectious Diseases, 2019. 19(1): p. 56-66.
2. Gasser, M. et al., The Lancet Infectious Diseases, 2019. 19(1): p. 17-18.
3. Colzani E. et al., PLoS One. 2017; 12(1): p. e0170662