

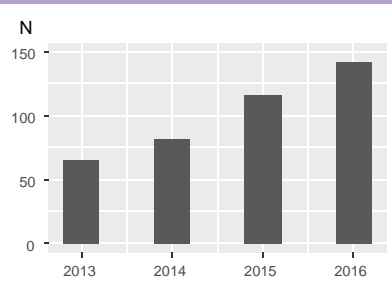
# Temporal trends and regional distribution of carbapenemase-producing *Enterobacteriaceae* in Switzerland from 2013 to 2016

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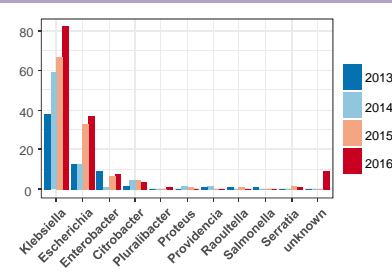
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## Introduction and purpose

Increasing rates of carbapenem-producing *Enterobacteriaceae* (CPE) in Europe and all over the world are of great concern because of the broad resistance to multiple antibiotics, which reduces considerably therapeutic options. So far no data was available for Switzerland and the aim of this study was to analyse CPE data available for Switzerland from 2013 to 2016.



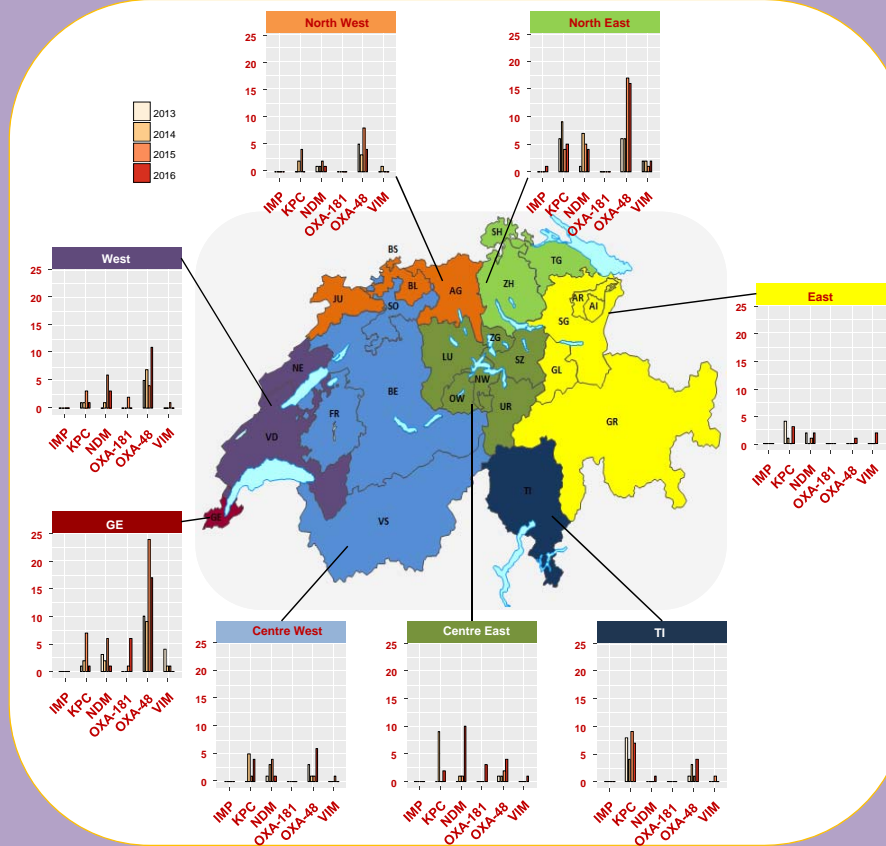
**Fig. 1.** Total number of CPE isolates. Data for years 2013-2015 are from 8 expert laboratories, and data for 2016 are from FOPH.



**Fig. 2.** Temporal distribution of the most prevalent CPE genera.

## Methods

In 2013 the Swiss Society for Microbiology defined a network of 8 Swiss expert laboratories, capable of identifying and characterizing CPE according to EUCAST guidelines. All Swiss microbiology laboratories were asked to send all suspected human CPE cases to one of the expert laboratories for characterizing the isolates. Data was then collated by the Swiss Antibiotic Resistance Centre ANRESIS for epidemiological analysis. In 2016 CPE was defined as notifiable disease by the Federal Office of Public Health, and data are from the mandatory reports to the FOPH.

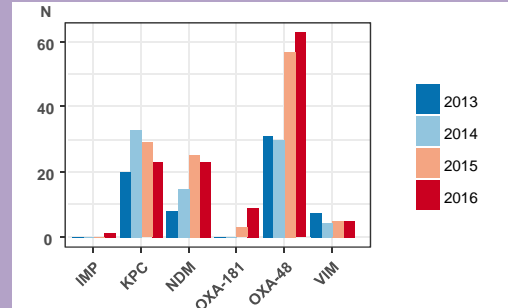


**Fig. 4** Regional and temporal distribution of CPE genotypes in Switzerland from 2013 to 2016.

## Results

After exclusion of duplicate entries, a total of 416 isolates originating from 361 patients were characterized, with 69, 89, 121, and 142 isolates reported from 2013, 2014, 2015 and 2016, respectively (**Fig. 1**). The species most frequently isolated were *Klebsiella pneumoniae* (n=240, 60%), *Escherichia coli* (n=95, 24%), and *Enterobacter spp.* (n=25, 6%) (**Fig. 2**). Out of 418 carbapenemase genotypes, the most frequently found were OXA (n=193, 46%, mostly OXA-48 with n=181, 43%), KPC (n=105, 25%) and NDM (n=71, 17%) (**Fig. 3**).

From 2013 to 2016, the number of KPC-harboring isolates was relatively stable (about 25 per year in total), whereas both numbers of NDM and OXA harboring isolates increased, from 9 to 25, and from 30 to 60 cases, respectively, in this time period. At the regional level, highest number of CPE isolates were identified in the Geneva and North East regions (**Fig. 4**; **Table 1**).



**Fig. 3.** Distribution of CPE genotypes over time.

	IRR	95% CI	Pvalue
<b>Year</b>	1.14	(1.04,1.26)	0.008 *
<b>Region</b>			
Centre West	0.68	(0.43,1.06)	0.087
East	0.90	(0.44,1.87)	0.783
GE	1.65	(1.02,2.68)	0.041 *
North East	1.17	(0.76,1.80)	0.482
North West	0.71	(0.44,1.16)	0.174
TI	0.85	(0.55,1.32)	0.462
West	1.16	(0.74,1.83)	0.523
<b>Sex (male)</b>	1.45	(1.16,1.81)	0.001 *
<b>Type of specimen</b>			
Blood	2.64	(1.80,3.88)	0.000 *
Respiratory tract	1.98	(1.34,2.92)	0.001 *
Stool	3.70	(2.60,5.27)	0.000 *
Urine	2.18	(1.58,3.00)	0.000 *
Wound	1.43	(0.94,2.16)	0.095

**Table 1.** Factors affecting the number of CPE isolates per canton per year. IRR: incident rate ratio; multivariable Poisson regression.

## Conclusions and outlook

Molecular data indicate a high diversity of different carbapenemases, with OXA-48, KPC- and NDM-type carbapenemases being the most prevalent in Switzerland. Overall OXA-48 and NDM producers are increasing as observed in other European countries such as in France.

Significant temporal and regional trends were found and the ongoing mandatory reporting scheme provides further epidemiological data that will help define possible interventions in the future.