

# **Epidemiology of Extended-Spectrum Beta-Lactamase (ESBL)-producing *E. coli* with special reference to outbreak detection**

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentlig försvaras i föreläsningssalen, Klinisk Mikrobiologi, Sahlgrenska Universitetssjukhuset, Guldhedsgatan 10A, Göteborg

**Tisdagen den 21 maj kl 9.00**

av  
Lisa Helldal

Fakultetsopponent:  
Professor Christian Giske  
Institutionen för laboratoriemedicin, Karolinska Institutet

## **Avhandlingen baseras på följande delarbeten**

- I. Helldal L\*, Karami N\*, Florén K, Welinder-Olsson C, Moore ER, Ahrén C. **Shift of CTX-M genotypes has determined the increased prevalence of extended-spectrum beta-lactamase-producing *Escherichia coli* in south-western Sweden.** *Clin Microbiol Infect.* 2013;19(2):E87-90. \*These authors contributed equally to this work
- II. Karami N, Helldal L, Welinder-Olsson C, Ahrén C, Moore ER. **Sub-typing of extended-spectrum-beta-lactamase-producing isolates from a nosocomial outbreak: application of a 10 loci generic *Escherichia coli* multi-locus variable number tandem repeat analysis.** *PLoS One.* 2013;8(12):e83030
- III. Helldal L, Karami N, Welinder-Olsson C, Moore ER, Ahrén C. **Evaluation of MLVA for epidemiological typing and outbreak detection of ESBL-producing *Escherichia coli* in Sweden.** *BMC Microbiol.* 2017;17(1):8:

**SAHLGRENKA AKADEMIN  
INSTITUTIONEN FÖR BIOMEDICIN**



# Epidemiology of Extended-Spectrum Beta-Lactamase (ESBL)-producing *E. coli* with special reference to outbreak detection

Lisa Helldal

Department of Infectious Diseases, Institute of Biomedicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

## ABSTRACT

Multidrug resistant bacteria, particularly extended-spectrum beta-lactamase (ESBL)-producing *Enterobacteriaceae* (EPE), are becoming a major health concern. ESBL-producing *Escherichia coli* (ESBL-*E. coli*) is the most prevalent type. ESBL-genes are carried on plasmids, often by bacteria belonging to clones with properties that facilitate transmission. An example is *E. coli* of sequence type (ST) 131, and its sublineage ST131-O25b. The most prevalent ESBLs world-wide are the CTX-M enzymes, most often belonging to the CTX-M-1 group. In **Paper I** the epidemiology of ESBL-*E. coli* causing urinary tract infection was studied from the first detected cases until these bacteria were established in the greater Gothenburg area. The first cases were seen in women from the community setting in 2003-2005. In 2008-2009, the elderly and men were also affected. The ST131-O25b sublineage became established during the study period, but otherwise the emergence of ESBL-*E. coli* was polyclonal. There was a shift in ESBL types in favor of the CTX-M-1 group enzymes. In **Papers II and III** PFGE, standard method for epidemiological typing at the time, was compared to other methods. For investigation of a polyclonal ESBL-*E. coli* outbreak, MLVA was found comparable to PFGE, whereas MLST analysis was not useful. For continuous epidemiological surveillance of ESBL-*E. coli*, both MLVA and MLST were inferior to PFGE, especially for typing the ST131-O25b sublineage. This thesis demonstrates how the epidemiology of ESBL-*E. coli* might change over time, emphasising the need of continuous surveillance using optimal typing methods to detect outbreaks at the local level. We propose that an abbreviated MLVA might be useful to preselect isolates for more discriminating typing methods.

**Keywords:** ESBL, *E. coli*, epidemiology, outbreak investigation, surveillance