The burden of multiresistant bacteria in German intensive care units

E. Meyer¹,²*, P. Gastmeier¹,² and F. Schwab¹,²

¹Institute of Hygiene and Environmental Medicine, Charité University Medicine Berlin, Berlin, Germany; ²National Reference Centre for Surveillance of Nosocomial Infections, Berlin, Germany

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*Correspondence address. Institute of Hygiene and Environmental Medicine, Charité University Medicine Berlin, Hindenburgdamm 27, 12203 Berlin, Germany. Tel: +49-03-8445-4883; Fax: +49-03-8445-3682; E-mail: elisabeth.meyer@charite.de

Sir,

Most surveillance systems report resistance rates or more precisely resistance proportions (RPs). However, proportions expressed as percentages may be misleading because they permit only a relative view of the problem. High proportions of resistance do not necessarily correlate with the actual burden of resistance on a ward or in a hospital or in a country. Dividing the number of resistant isolates by the total number of the isolates of the species tested may result in high rates, even if the numerator and denominator are very small—resistance may be common but the pathogen actually rare. Therefore, the burden of resistance, with all the consequences involved, and changes in resistance are better described—from a public health perspective—as resistance density (RD), i.e. the absolute number of resistant pathogens in a population over time.¹

The aim of this study was to analyse the burden of multiresistant pathogens from January 2001 to December 2007 in German intensive care units (ICUs), which voluntarily participated in the project Surveillance of Antimicrobial Use and Bacterial Resistance in Intensive Care Units (SARI).

Forty-seven ICUs were included in the analysis and provided data on 1 135 102 patient-days (pd).

We used time-series analysis with quarterly data to assess the changes over time. The significance level was set at P = 0.05. The R² statistic was calculated as a measure to evaluate the goodness of fit of the linear regression model to the data. The method of SARI is described in detail elsewhere.²,³

A total of 23 783 Staphylococcus aureus were tested, and 5151 isolates were found to be resistant to methicillin (MRSA). One hundred and seventy-six of the 15 034 Enterococcus faecium or Enterococcus faecalis were vancomycin-resistant (VRE), and 677 of the 15 516 Escherichia coli and 438 of the 6139 Klebsiella pneumoniae isolates were resistant to third-generation cephalosporins (3GCR). The highest burden of resistance turned out to be MRSA by far (Figure 1). However, the burden of MRSA did not change over 7 years, whereas the burden of 3GCR E. coli has continuously increased by 0.047 resistant pathogens/1000 pd per quarter. The determination coefficient (R²) of the final model was 0.623, i.e. 62.3% of the variations of the quarterly 3GCR E. coli were explained by the model. The RD of 3GCR E. coli in 2007 is already equivalent to one-third of the overall RD of MRSA.

The corresponding mean yearly RPs from 2001 to 2007 were: for MRSA, 26.3%, 22.2%, 20.8%, 19.5%, 22.3%, 22.1% and 20.3%; for VRE, 0.7%, 0.3%, 0.3%, 1.7%, 2.2%, 1.0% and 1.7%; for 3GCR K. pneumoniae, 3.9%, 13.1%, 6.1%, 65%, 6.6%, 6.1% and 8.0%; and for 3GCR E. coli, 1.1%, 1.7%, 2.9%, 3.6%, 3.5%, 5.0% and 10.9%, respectively.

This is the first study on the burden of selected resistant pathogens in German ICUs over a period of 7 years.

The most striking result was the continuous increase in the RD of 3GCR E. coli from 2001 to 2007, which was paralleled by increasing RPs. VRE peaked due to an outbreak in a few ICUs in the south-west of Germany, but showed nevertheless a significant increase over time. In contrast, the burden of MRSA stayed stable over the 7 years.

In a recent study in ICUs in six Singapore hospitals, RPs of MRSA and 3GCR E. coli were 46.7% and 33.4%, respectively, in 2006. However, the RD was 4.5 and 1.4, respectively, and ranged at the same level as in SARI-ICUs, i.e. 4.4 and 1.5 (data from 2007).¹ In comparison, the RPs in SARI-ICUs were 2.3 and 3.1 times lower (20.3% MRSA and 10.9% 3GCR E. coli). This illustrates clearly the different information given by the different resistance parameters. It is generally agreed that resistance is higher in Asia or in the USA than in Central Europe. However, it is not exactly known whether the burden of resistant pathogens differs.

3GCR E. coli as an indicator for the production of extended-spectrum β-lactamases (ESBLs) has increased 10-fold over recent years. Since 2000, the epidemiology of ESBLs has changed dramatically. Until recently, most infections caused by ESBL-producing bacteria have been described as nosocomial-acquired, often appearing in specialized units. Infections due to ESBL producers are now increasingly found in non-hospitalized
patients, and the mode of transmission or the source of this pathogen is still unknown.

The results of our study show an alarming and continuous increase in the burden of 3GCR \textit{E. coli}. Although RPs are indispensable for the empirical choice of antibiotic treatment as they take the local resistance situation into account, we advocate for an additional resistance parameter expressing the burden of resistance for national or international surveillance systems. In the face of resistant pathogens, we find it far better to describe and compare the burden of resistance and the magnitude of the public health problem by RDs.

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**Transparency declarations**

None to declare.

**References**


![Figure 1. Burden of resistance expressed as resistant pathogens per 1000 pd of methicillin-resistant \textit{S. aureus} (MRSA), vancomycin-resistant \textit{E. faecium} and \textit{E. faecalis} (VRE) and third-generation cephalosporin-resistant (3GCR) \textit{K. pneumoniae} (KPN) and \textit{E. coli} (ECO) in German ICUs (n = 47) from 2001 to 2007, and results of the time-series analysis.]
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