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**Article:**

Pulcini, C, Beovic, B, Howard, P [orcid.org/0000-0002-5096-0240](https://orcid.org/0000-0002-5096-0240) et al. (1 more author) (2018) Human resources estimates and funding for antibiotic stewardship teams are urgently needed: authors' response. *Clinical Microbiology and Infection*, 24 (5). p. 557. ISSN 1198-743X

<https://doi.org/10.1016/j.cmi.2018.01.009>

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Letter

**Human resources estimates for antibiotic stewardship teams: evidence-based approaches for recommendations are needed**

Thomas Harder <sup>1\*</sup> ([hardert@rki.de](mailto:hardert@rki.de))

Tim Eckmanns <sup>1</sup> ([eckmannst@rki.de](mailto:eckmannst@rki.de))

Nicole Schmidt <sup>1</sup> ([schmidtn@rki.de](mailto:schmidtn@rki.de))

Winfried V. Kern <sup>2</sup> ([winfried.kern@uniklinik-freiburg.de](mailto:winfried.kern@uniklinik-freiburg.de))

Muna Abu Sin <sup>1</sup> ([abu-sinm@rki.de](mailto:abu-sinm@rki.de))

<sup>1</sup> Robert Koch Institute, Berlin, Germany

<sup>2</sup> Division of Infectious Diseases, Department of Medicine, University Hospital and Medical Center, Freiburg, Germany

\*Corresponding author: Dr. Thomas Harder, MD, MSc, Robert Koch Institute, Department of Infectious Disease Epidemiology, Seestrasse 10, 13353 Berlin, Germany; Email: HarderT@rki.de, Telephone: 0049-30-18754-3565, Fax: 0049-18754-3565

Sir,

In their commentary, Pulcini et al. (1) compared staffing recommendations for antibiotic stewardship (AS) teams in hospitals from different countries including the sources used to define these recommendations and called for further studies on staffing standards. However, before conducting new studies, we think it is important to assess the currently available evidence on this topic. We therefore re-analyzed two recently published systematic reviews on AS programs (2, 3). We extracted information on human resources used in the included studies from the original publications. A total of 19 studies were identified which reported details on AS team composition (**Table 1**). The studies were published between 2003 and 2016 and were conducted in 13 different high- or middle-income countries. The AS programs assessed in these studies widely differed in structure, components, and focus of the intervention (e.g. fluoroquinolone restriction or prescribing quality in general). The settings in which the AS programs were implemented showed a high variability, ranging from 12-bed ICU to 1800-bed hospital. Consequently, the AS teams reported in the publications varied in size and composition, ranging from one infectious disease physician to large teams with more than ten members. Remarkably, only six studies reported estimates of full-time equivalents, while in 11 publications it was unclear how much effort and time were spent by the individual members of the AS teams to implement and conduct the program. In some papers, information on staffing of the AS program was hidden in the Discussion section. Moreover, we suspect that both systematic reviews analyzed here did not comprehensively cover this topic since several studies which provide details on human resources were not included (4, 5). Information on staffing is essentially needed to compare AS programs and to provide exact calculations in terms of human resources and costs. Therefore, we suggest that detailed reporting of human resources used in relation to the respective setting should become standard for publications on AS programs, preferentially in the Methods and Results sections of the paper. In that sense, we would welcome the inclusion of a respective item in the recently published reporting checklist for epidemiological studies on antimicrobial resistance (STROBE-AMS) under methods setting and generalizability (6). To

our opinion, this will greatly enhance the value of reports on AS programs and pave the way towards informing and developing evidence-based recommendations on human resource needs for AS programs.

**Table 1**

Studies on antimicrobial stewardship programs with information on human resources (AS team)

<b>Study</b>	<b>Country</b>	<b>Program description</b>	<b>Setting</b>	<b>AS team</b>
Amer et al., 2013(7)	Saudi Arabia	Preapproval strategy; audit and feedback; education; guidelines; dose optimization; antimicrobial cycling	20-bed ICU	- Intensivist/ID physician - ASP pharmacist
Apisarnthanarak et al., 2006 (8)	Thailand	Education; feedback; bedside discussion; prescription forms; antibiogram; computerized system recording	350-bed tertiary care university hospital	- ID physician - clinical microbiologist - 4 pharmacists - 2 internists - hospital epidemiologist - IC specialist - computer system analyst
Bantar et al., 2003 (9)	Argentina	AB order form; feedback; bedside discussion	250-bed teaching hospital + 10-bed ICU	- ID physician - clinical microbiologist - laboratory microbiologist - 2 pharmacists - internist - computer system analyst
Borde et al., 2014 (10)	Germany	Guideline; information and education; regular ward rounds and intensified ID consultations; feedback and audit	300-bed medical service (of 1600 bed academic teaching hospital)	- Senior physician (0.35 FTE) - ID fellow (0.75 FTE) - Pharmacist (0.12 FTE) - Data manager (0.06 FTE)
Borde et al., 2015 (11)	Germany	Daily rounds; written guidelines	200-bed community hospital + 10-bed ICU	- ID physician (0.25 FTE)
Boyles et al., 2013 (12)	South Africa	AB prescription chart; ABS ward rounds; audit	two 32-bed medical wards	- ID specialist - consultant microbiologist - IC nurse - ward pharmacist
Cisneros et al., 2014 (13)	Spain	Counseling interviews; guidelines	1251-bed tertiary care teaching hospital with 90 ICU beds	- ID specialist - pharmacist - intensive care specialist - paediatrician - microbiologist - expert in clinical documentation
Cook et al., 2004(14)	USA	Enhanced feedback after two preauthorization approvals for restricted AB; treatment days for controlled AB	731-bed tertiary care teaching hospital	- ID physician - pharmacist
Leung et al., 2011 (15)	Canada	Audit and feedback	12-bed ICU	- Physician (0.5 FTE) - Pharmacist (1.0 FTE)
Lin et al., 2013 (16)	Taiwan	Restriction; education; ward rounds; bedside evaluation; audit	415-bed community public teaching hospital	- Infection specialist (0.60 FTE) - 2 pharmacists (0.5 FTE each) - 2 infection control nurses (0.2 FTE each)

Malani et al., 2013 (17)	USA	Audit	535-bed hospital	- 2 ID physicians (0.3 FTE total) - 3 critical care clinical pharmacists (no dedicated stewardship time)
Marra et al., 2009 (18)	Brazil	AB restriction and audit	38-bed medical-surgical unit	- ID physician - pharmacist
Meyer et al., 2007 (19)	Germany	Guideline; education	12-bed ICU	- IC specialist - infection control physician - occasionally: microbiologist, pharmacist
Ng et al., 2008 (20)	Hong Kong	Guideline; education; feedback; monthly AB consumption; cost monitoring; AB susceptibility reporting	1800-bed hospital	- physicians - microbiologist - ID specialist - pharmacist (detailed cost calculation reported)
Niwa et al., 2012 (21)	Japan	Review of AB orders; restricted duration of use; education; feedback; printed information	606-bed university hospital	- IC doctor - pharmacist - nurse - microbiological technologist
Pate et al., 2012 (22)	USA	Audit; consultation	60-bed hospital	- medical director for infection control (10 hours/month) - director of pharmacy (clinical pharmacist; 5 hours/week)
Storey et al., 2012 (23)	USA	Audit; feedback	43-bed medical-surgical services	- ID physician medical director of infection control - clinical pharmacy supervisor - pharmacy director
Takesue et al., 2010 (24)	Japan	AB cycling; restriction; audit	910-bed university hospital	- 2 ID physicians - pharmacist - IC nurse - additional input from a microbiologist
Yeo et al., 2012 (25)	Singapore	Audit; feedback	990-bed tertiary public teaching hospital	- clinical pharmacist (full-time) - clinical microbiologist (0.1 FTE) - ID physician (0.1 FTE)

AB, antibiotics; ASP, antimicrobial stewardship program; FTE, full-time equivalent; IC, infection control; ICU, intensive care unit; ID, infectious disease

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