COMMENTARY

Human resources estimates and funding for antibiotic stewardship teams are urgently needed

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Antibiotic stewardship (AS) teams are essential actors for combatting antibiotic-resistant bacteria in healthcare and community settings, and are routinely mentioned in national and international guidelines, recommendations and action plans. Usually, AS teams in resource-rich settings are multidisciplinary, made up of different experts, commonly including infectious diseases (ID) specialists, clinical microbiologists and pharmacists, adequately trained in antibiotic prescribing and stewardship [1]. Some studies conducted in low- and middle-income countries (LMICs) have also shown that community health workers, nurses, village women, and others have important roles [1]. Antibiotic stewardship teams are in charge of implementing AS programmes in a specific setting (hospital, community, long-term care facility) or sometimes in different settings, using a cross-sectoral approach [1].

Despite the importance of stewardship teams in optimising the management of infections, they remain understaffed or non-existent in most countries [2], and when they do exist, they tend to be focused in hospitals, even though the vast majority of antibiotics are prescribed in the community. A few countries have implemented regulatory measures making hospital stewardship teams mandatory (e.g. Australia, Belgium, Canada, France, Germany, the Netherlands, Norway, UK or the US), but even these requirements are not always enforced in practice.

Two main actions are required to meet the human resource needs for stewardship across countries; first, there is a need for staffing standards (e.g. *n* full-time equivalent [FTE] per capita), based on the list of core actions stewardship teams must implement. Second, a sustainable funding mechanism is needed to ensure that experts in stewardship are employed and have dedicated time for their task. Accepted international norms and standards for infection prevention and control practitioners (per number of hospital beds) have been

developed and implemented in some high-income countries, although high heterogeneity still exists at global level. A recently published literature review concluded that 'an effective infection-control programme in an acute-care hospital must include as a minimum standard at least one full-time specifically trained infection-control nurse per up to 250 beds and a dedicated physician trained in infection control' [3].

To the best of our knowledge, only a handful of countries have established staffing standards for stewardship teams, and these figures only exist for hospitals [4]. The 2016 European Centre for Disease prevention and Control (ECDC) 'Proposals for European Union (EU) guidelines on the prudent use of antimicrobials in humans' recommended salary support and dedicated time for antimicrobial stewardship hospital-based activities, for example 2-6 FTE per 1000 acute care beds, based on an expert consensus and citing French and German-Austrian recommendations [5-7]. American colleagues recently suggested 2 FTE ID physician and 1 FTE ID-trained clinical pharmacist for every 1000 acute care hospital beds in the US [8]. In 2017, members of ESGAP (the ESCMID Study Group for Antimicrobial stewardshiP) from 26 different countries replied to a short e-mail survey about staffing recommendations in their own country; these only existed at national level for hospital-based stewardship teams in Australia, Canada, France, Germany, and the Netherlands (Table). The observed variation in staffing figures comes from the use of different methodologies to calculate the standards, and also reflects different healthcare systems and organisation of care.

Importantly, the list of core activities of AS teams also varies between countries. In some countries, such as the Netherlands, some baseline functions of ID physicians, microbiologists and pharmacists may not be accounted for in the FTE staffing figures, as they are already considered standard of care. Also in Belgium, as of July 2007, all acute care hospitals and chronic care hospitals with >150 beds receive financial support from the federal

100 government for hiring a trained antibiotic treatment manager for their AS teams. To this end,
101 an annual budget of 4.3 million euros is divided among hospitals according to their number of
102 beds (around 81,700 euros per 1000 beds, corresponding to 0.8 FTE/1000 beds) [9]. The
103 funding however only concerns one person supervising implementation of the AS
104 programme, not the whole AS team needed to implement all actions on a daily basis (e.g.
105 ward rounds, systematic advice for specific situations…). On the contrary, in France, the list
106 of core activities AS teams have to implement is much longer, and includes supervision of the
107 programme as well as actions such as daily advice to prescribers; hospital-based AS teams are
108 also expected to participate in AS activities in outpatient regional networks [7]. A list of core
109 AS activities certainly needs to be agreed upon globally, in addition to the list of basic
110 resources (e.g. diagnostics, pharmacy services) that must be in place for an AS programme to
111 function properly.
112
113 The need for a global funding mechanism to address human resources for stewardship,
114 infection prevention and other non-drug development measures has been highlighted [10], but
115 remains elusive. Although more keenly felt in LMICs, we believe that it is pertinent to all
116 countries, as sustainable protected time for stewardship activities is often lacking. The role of
117 the funding would be to train and retain core healthcare professionals and provide essential
118 support staff (e.g. administrative staff and data support). Funding for AS should not come
119 from the assumed cost savings deriving from the lower drugs expenses, but rather should be
120 an inherent part of patient safety and healthcare quality-related spending.
121 This is especially urgent given the increasing difficulty to bring new antibiotics to
122 market and the dramatic sums of public money that will likely be needed to do so. While the
123 cost of stewardship will seem very small relative to these R&D investments it must not be an
124 afterthought [11]. Indeed it is essential that future stewardship activity has its own earmarked

funding stream within any new antibiotic incentive scheme if we are to have any chance of protecting these new drugs if and when they make to market.

In conclusion, it is time we focussed more on optimising the use of antibiotics, globally. We need further studies to identify the minimum international staffing standards for stewardship teams. This should go beyond hospitals, and should include also the community setting and long-term care facilities. This call recognizes the fact that as standards are put in place, they must take into account different models of stewardship delivery, where both traditional role players and others such as non-specialist pharmacists, nurses, and community health workers can be part of AS teams. We call for the development of global estimates of funding needs for basic and core antibiotic stewardship activities across all healthcare settings (Box). This is the first step in a long road towards a global funding mechanism to ensure compliance with the standards.

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TABLE – Staffing recommendations available at country level for antimicrobial stewardship teams in hospitals

Country	How these standards were defined	Staffing standards	Reference
Australia	Antimicrobial stewardship in Australian hospitals (Second edition due 2017)	There is no consensus on staffing recommendations in Australia within the national accreditation standards. Recommendations from 2011: clinicians in hospitals with existing programs suggest that for every 100 acute beds, at least 10 hours (0.3 full-time equivalent) of senior pharmacist and 3.5 hours (0.1 full-time equivalent) of lead clinician time per week should be dedicated to AMS activities. **Minimum for the team: 4 FTE/1000 acute care beds.** For rural regional hospitals access to experts through networks or telehealth is recommended.	[12]
Canada	Based on an environmental scan, survey of the medical literature, and expert opinion of the Antimicrobial Stewardship and Resistance Committee	**Core Team Members (minimum recommended): total of 4.9 FTE/1000 acute care beds** Physician: 1.0 FTE per 1000 acute care beds Pharmacist: 3.0 FTE per 1000 acute care beds Project/Program Administrative and Coordination Support: 0.5 FTE per 1000 acute care beds Data Analyst: 0.4 FTE per 1000 acute care beds	[13]
Austria and Germany	Guideline by the German Society for Infectious Diseases, based on the literature and expert advice	**Antibiotic stewardship team: minimum of 2 FTE per 1000 beds**. The team should consist of at least one infectious diseases physician (or clinician with infectious diseases training) and an experienced clinical pharmacist/hospital pharmacist, as well as a specialist in microbiology.	[6]
France	Nationwide survey in 65 hospitals, conducted in 2015 by	**Optimal** standards for the whole AMS team: - 3.6 FTE/1000 acute care beds for	[7]

	a Task force on antimicrobial resistance coordinated by the Ministry of Health	infection specialists (medical doctors, ideally infectious diseases specialists) - 2.5 FTE/1000 acute care beds for pharmacists - and 0.6 FTE/1000 acute care beds for microbiologists - i.e. a **total of 6.7 FTE/1000 acute care beds for the whole AMS team**	
The Netherlands	National consensus procedure	**Optimal standards for the whole AMS team**: *Start-up phase* Hospital < 300 beds -100 hours one time + 0.87 FTE per year Hospital 300 – 750 beds -100 hours one time + 1.2 FTE per year Hospital > 750 beds -100 hours one time + 2.5 FTE per year *Consolidation phase* Hospital < 300 beds : 1.25 FTE per year Hospital 300 – 750 beds : 2.14 FTE per year Hospital > 750 beds : **3.0 FTE** / year	[14]

188 AMS : Antimicrobial stewardship; FTE : full-time equivalent

BOX – Steps urgently needed to move forward

1. Draw up minimum staffing standards for antibiotic stewardship teams that can be used globally. The simplest place to start is probably hospital-based stewardship activities. The first step would be to come up with a list of core antibiotic stewardship activities that would be applicable worldwide, based on a literature review and consensus procedure involving an international panel of experts. The next step would be to estimate the human resources needed to complete all these activities, based on data coming from existing fully implemented and successful programmes in a representative sample of hospitals, completed by experts' opinion.
2. Apply costs to these standards for a sample of low-, middle- and high-income countries.
3. Identify potential funding sources to support health systems to cover these costs.