White Paper: Bridging the gap between surveillance data and antimicrobial stewardship in long-term care facilities—practical guidance from the JPIAMR ARCH and COMBACTE-MAGNET EPI-Net networks

Marcella Sibani[1]†, Fulvia Mazzaferri[1]*†, Elena Carrara[1], Maria Diletta Pezzani[1], Fabiana Arieti[1], Siri Göpel[2,3], Mical Paul[4], Evelina Tacconelli[1,2,3], Nico T. Mutters[5]‡ and Andreas Voss[6]‡ on behalf of the ARCH working group§

[1]Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; [2]Infectious Diseases, Department of Internal Medicine I, Tübingen University Hospital, Tübingen, Germany; [3]German Centre for Infection Research (DZIF), Clinical Research Unit for Healthcare Associated Infections, Tübingen, Germany; [4]Diseases Institute, Rambam Health Care Campus, Ruth and Bruce Rappaport Faculty of Medicine, Technion - Israel Institute of Technology, Haifa, Israel; [5]Institute for Hygiene and Public Health, Bonn University Hospital, Bonn, Germany; [6]Department of Medical Microbiology, Radboud University Medical Centre, Nijmegen, The Netherlands

*Corresponding author. E-mail: fulvia.mazzaferri@univr.it
†Equally contributing first authors.
‡Equally contributing last authors.
§Members are listed in the Acknowledgements section.

Background: In long-term care facilities (LTCFs) residents often receive inappropriate antibiotic treatment and infection prevention and control practices are frequently inadequate, thus favouring acquisition of MDR organisms. There is increasing evidence in the literature describing antimicrobial stewardship (AMS) activities in LTCFs, but practical guidance on how surveillance data should be linked with AMS activities in this setting is lacking. To bridge this gap, the JPIAMR ARCH and COMBACTE-MAGNET EPI-Net networks joined their efforts to provide practical guidance for linking surveillance data with AMS activities.

Materials and methods: Considering the three main topics [AMS leadership and accountability, antimicrobial usage (AMU) and AMS, and antimicrobial resistance (AMR) and AMS], a literature review was performed and a list of target actions was developed. Consensus on target actions was reached through a RAND-modified Delphi process involving 40 experts from 18 countries and different professional backgrounds adopting a One Health approach.

Results: From the 25 documents identified, 25 target actions were retrieved and proposed for expert evaluation. The consensus process produced a practical checklist including 23 target actions, differentiating between essential and desirable targets according to clinical relevance and feasibility. Flexible proposals for AMS team composition and leadership were provided, with a strong emphasis on the need for well-defined and adequately supported roles and responsibilities. Specific antimicrobial classes, AMU metrics, pathogens and resistance patterns to be monitored are addressed. Effective reporting strategies are described.

Conclusions: The proposed checklist represents a practical tool to support local AMS teams across a wide range of care delivery organization and availability of resources.

Introduction

Long-term care facilities (LTCFs) are generally defined as institutions that provide healthcare to people who are unable to manage independently in the community. LTCFs offer multiple and heterogeneous services, ranging from chronic management (e.g. residential care facilities and nursing homes) to post-acute care (e.g. rehabilitative services). LTCF residents are often elderly or frail with comorbidities and an impaired immune system that increases their risk of exposure to antibiotics that are frequently unnecessary or inappropriate.[1,2] For these reasons, combined with poor infection prevention and control (IPC) practices, LTCFs bear a disproportionate burden of *Clostridioides difficile* infections and

MDR organisms, and are a major contributor to their dissemination in a given geographic region.[3] In this setting, such infections are associated with increased morbidity, mortality and costs.[4,5]

Antimicrobial stewardship (AMS) programmes have been shown to be efficacious in decreasing the prevalence of some strains of antibiotic-resistant bacteria, reducing the incidence of *C. difficile* infections and, in some cases, improving patient outcomes in acute care settings, where the evidence and experience describing AMS is sufficient to support guidance documents.[6] In comparison, relatively few studies have assessed the effectiveness of AMS programmes in LTCF settings, and most have been conducted in academic- or hospital-affiliated LTCFs and focus on decreasing antibiotic use without assessing the impact on clinical outcomes (e.g. hospitalization, incidence of *C. difficile* infections).[7–10] Lack of evidence, scarce resources, poor coordination of medical care and absence of reports are significant barriers to the implementation of AMS programmes in LTCFs, which tend to be less well organized than in acute care facilities.[11] Nonetheless, minimal standards of an AMS programme that includes a system to monitor antibiotic use and AMR are becoming widely required in the LTCF setting, with further suggestions for expanded programmes in selected facilities with particular skills and resources.[12]

Antimicrobials are among the most frequently prescribed medications in LTCFs and exhibit the second-highest rate of adverse drug events after antipsychotic medications.[13] Ibrahim and Polk[14] stated that a successful AMS programme should measure both antibiotic use, to detect a change in use after the interventions, and an outcome that is related to the observed change in use. Nevertheless, metrics for antibiotic use have not been clearly reported in the main guidance documents related to AMS in LTCFs.

High-quality and timely AMR surveillance plays a pivotal role in AMS programmes, and provides essential information to the AMS team to drive appropriate empirical antimicrobial therapy; many factors influence the AMR rate in LTCFs, including prevalence in the community, the type of care provided (e.g. enteral feeding, urinary catheter, chronic wounds) and adherence to IPC measures. Previous reviews have raised several concerns in connecting AMR surveillance with AMS, mainly due to the lack of reliable and sustainable surveillance activities at local and national levels and limited automated links between routine AMR data and clinical or background data, especially in healthcare settings other than hospitals.[15]

The JPIAMR ARCH and COMBACTE-MAGNET EPI-Net networks have the goal of providing a framework with practical actions to facilitate antibiotic policy interventions.[16,17]

The ARCH and COMBACTE-MAGNET EPI-Net international expert panel has produced a series of four White Papers to develop practical checklists and overview epidemiological, microbiological and antimicrobial data. The following specific topics were addressed: (i) AMS leadership and accountability; (ii) antimicrobial usage (AMU) and AMS; and (iii) AMR and AMS. The practical framework is intended to combine surveillance reports of AMU and AMR with AMS policy interventions tailored to the LTCF setting using a One Health approach that places the focus on practical applicability in heterogeneous economic settings that include low- and middle-income countries (LMICs). This White Paper focuses on LTCFs; for this purpose we adopted the definition and classification of an LTCF according to the protocol for point prevalence surveys of healthcare-associated infections (HAIs) and antimicrobial use in European LTCFs (Table 1).[18] The intended audience is healthcare professionals/AMS teams who are striving to build preparedness and fruitfully use AMU and AMR data to design AMS programme at their institution, in the context of limited evidence and wide variability of national requirements, local healthcare organization and availability of expertise. Dissemination will be ensured by the networks involved in the JPIAMR ARCH project as listed in Table 1 of the first paper in this series.[19] Checklist formats of the target actions for the four settings, to be used by health professionals and policymakers to establish and/or monitor stewardship activities, are available for download on the ARCH website.[16]

Methods

Using a One Health approach, the present project was conceived to develop expert consensus based on the available literature and guidance documents on AMS and surveillance. This was followed by the development of a first draft of targets and RAND-modified Delphi process for the definitive validation of targets (protocol available on the ARCH website).[16] The process is discussed in the first paper in this series in the hospital setting.[19] Briefly, the process involved the following: development of key research questions (listed in Table 3 of the first paper in this series) based on a previous systematic review on surveillance reporting of AMR and AMU in the

Table 1. Definition of long-term care facilities (LTCFs)[18]

General definition of an LTCF

Organization and delivery of a broad range of services and assistance to people who are limited in their ability to function independently on a daily basis, over an extended period of time. Additionally, there is often a need for basic medical services (wound dressing, pain management, medication, health monitoring, prevention, rehabilitation or palliative care). LTCFs typically have residents who:

- need constant supervision (24 h a day)
- need 'high-skilled nursing care', i.e. more than 'basic' nursing care and assistance for daily living activities
- are medically stable and do not need constant 'specialized medical care' (i.e. care administered by specialized physicians)
- do not need invasive medical procedures (e.g. ventilation)

General nursing homes: In these facilities, residents need medical or skilled nursing and supervision 24 h a day. These facilities provide principally care to seniors with severe illnesses or injuries.

Specialized LTCFs: These facilities are specialized in one specific type of care; e.g. physical impairment, chronic diseases such as multiple sclerosis, dementia, psychiatric illnesses, rehabilitation care, palliative care and intensive care.

Mixed LTCFs: These facilities provide different types of care in the same facility (a mix of the above-mentioned types of LTCF).

Residential homes: In these facilities, residents are unable to live independently. They require supervision and assistance for the activities of daily living. These facilities usually include personal care, housekeeping and three meals a day.

Other LTCFs: Other facilities not classifiable among the above-mentioned LTCF types.

hospital setting (EPI-Net COACH project);[19,20] a narrative review of the available evidence on LTCFs; the production of a first draft of targets; a web-based survey in which agreement was expressed on a nine-point Likert scale; and a 2 day face-to-face experts' meeting held at the end of October 2019. Six members with additional know-how in research and implementation of AMS in LTCFs formed the working group that reviewed the evidence and finalized the recommendations for this specific setting. The literature search was carried out using MEDLINE (National Library of Medicine, Bethesda, MD, USA), combining search terms for the following key concepts: antimicrobial consumption; antimicrobial resistance; surveillance; nursing homes; long-term care facilities. Four reviewers (M.D.P., E.C., F.M., M.S.) examined relevant publications in English, published in the last 10 years, using a step-wise approach, first assessing guidance (from scientific societies and international and national authorities) and documents included in the EU-JAMRAI repository,[21] and then searching PubMed for other significant publications addressing AMS in LTCFs. Recommendations, state of the art and original approaches were evaluated to compile a list of 'essential' and 'desirable' targets. Targets were recognized as 'essential' when widely practicable if not already broadly accomplished, and 'desirable' in the case of limited feasibility or resource constraints. Survey results were discussed and approved by the entire expert panel. Topics for which more evidence was required in order to draw up recommendations were defined as priority topics for future research. A total of 40 experts from 18 countries and representing 30 networks developed the protocol, contributed to reaching consensus and approved the final list of indications (see first paper in this series).[19]

Results

Evidence inherent to AMR surveillance and AMU data employed to inform AMS in LTCFs was retrieved from 25 publications (10 guidance documents, 7 expert consensus and reviews, 3 surveillance reports and 5 AMS interventional studies).[7,12,13,22–41] These were evaluated against the key research questions to produce a list of 25 draft target actions, 13 qualified as 'essential' and 12 as 'desirable' targets. Five research questions were directly proposed as 'topics for further research', since no answers or relevant strategies to address them could be found in the available literature: 'Should a ranking for antibiotic use be adopted in the report?'; 'Should non-clinical samples (e.g. screening) be monitored?'; 'Should specific thresholds be set for driving AMS recommendations for empirical therapy?'; 'Should specific thresholds be set for driving AMS recommendations for medical and surgical prophylaxis?'; and 'Which criteria should be used to drive selective reporting of antibiograms?'.

Twenty experts completed the online survey. All but one of the 25 targets surveyed ('Deliver a report on local AMR surveillance data to the resident and family council, if such a council is in place') reached the agreement threshold. Fifteen targets, although meeting agreement, received relevant comments and requests for rephrasing or additional evaluation during the subsequent face-to-face discussion. The entire set of 25 target actions was discussed by the expert group. The dedicated LTCF working group then drafted a set of 23 targets (17 were retained in their original formulation, 1 essential and 5 desirable targets were rephrased and 2 desirable targets were deleted) that were approved by all experts. Tables 2–4, respectively, list the recommended targets for the AMS team, AMU and AMS, and AMR and AMS.

Discussion

Definition of roles and accountability is an essential prerequisite for any AMS programme. In LTCFs, widely differing organizational structures, types of residents and levels of care provided leads to a wide variability of staffing resources and expertise, even within the same healthcare system. A constant feature of LTCFs is that key AMS professionals (infectious disease physicians, pharmacists, microbiologists) are usually based off-site and prescribing can be carried out by professionals who are not directly employed by the facility (i.e. resident's GPs or out-of-hours medical services).[42,43] While national regulations for AMS activities and/or mandatory IPCs for LTCFs are in place in some countries, they are difficult to generalize due to the intrinsic variability of this specific setting.[30,32,42] Therefore, the expert panel endeavoured to transpose recommendations on composition of the AMS team by adopting a flexible approach.[7,12,13,22,27] The inclusion in AMS activities of both medical (for clinical guidance) and nursing (assuring the continuity of care) professions was deemed essential. The safety and quality of services should be at the core level of programme coordination. Thus, the Director of Nursing, Medical Director and Administrator are usually appointed for this role.[12] Where more resources are available, officially appointing a coordinator physician and nurse with specific expertise in AMS and IPC is also a promising strategy.[30,42] The other core competencies (i.e. pharmacy, microbiology and IPC) can be ensured by engaging external consultants.[43]

Table 2. Leadership commitment, accountability, and antimicrobial stewardship team

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Participants in the antimicrobial stewardship team

1.1. Essential
The AMS team should be multidisciplinary. The core members should be leaders with experience in AMS and surveillance with a profile of medical facility director and nurse director (or officially appointed physician/nurse).
1.2. Desirable
Include additional professionals in the core group according to the setting, resources and type of intervention (i.e. other specialists from target wards, infection control nurses, IT experts).

Institutional support for organization and management of antimicrobial stewardship programmes: legal framework

1.3. Essential
Regulate and promote AMS activities at every level of healthcare organization with well-defined roles, responsibilities and a clear governance structure.

Institutional support for the organization and management of antimicrobial stewardship programmes: staffing personnel

1.4. Essential
Include specific salary support and dedicated time for antimicrobial stewardship activities as part of antimicrobial stewardship programmes.
1.5. Essential
Allocate full-time equivalents according to national requirements for the different settings and levels of intervention, where available.

Table 3. Antimicrobial usage and antimicrobial stewardship

Which antibiotics should be monitored?

2.1. Essential
Monitor:
- overall consumption of antibiotics
- IV and oral antibiotics used in high volumes or according to the local ranking (5–10 most used agents)
- antimicrobials included in the Watch and Reserve categories of the WHO Essential Drug List AWARE index
- antibiotics used for treating infections caused by local clinically relevant resistant pathogens as defined by the AMS team.

2.2. Desirable
Monitor the total consumption of systemic antibiotics (ATC J01 class), both IV and oral formulations, as overall aggregated data and subclasses
   (J01A, J01B, J01D, J01E, J01F, J01G, J01M, J01X) or individual agents.
2.3. Desirable
Stratify antibiotic consumption by indication/syndrome (e.g. UTI) and by formulation (e.g. oral, IV, IM).

Which metrics should be employed for antimicrobial usage monitoring?

2.4. Essential
In general, nursing homes, specialized LTCFs and mixed LTCFs (as defined in Table 1): monitor DOTs and/or antibiotic starts and/or DDDs.
2.5. Essential
In residential homes, monitor antibiotic use with a cross-sectional approach (e.g. point prevalence survey).
2.6. Desirable
In residential homes, monitor DOTs and/or antibiotic starts and/or DDDs.
2.7. Essential
In all LTCFs, where there is variation in monthly census data, monitor AMU with incidence density measures (e.g. antibiotic starts or DOT or DDD per
   1000 resident-days). Where monthly census data are stable, monitor counts (e.g. number of antibiotic starts per month).
2.8. Desirable
For surveillance at a prescriber level, monitor DDD per 100 residents per year.
2.9. Desirable
Supplement antibiotic use measure(s) with assessments of appropriateness (e.g. indication and/or duration of treatment).

Who should receive the report from the antimicrobial stewardship team?

2.10. Essential
Deliver a report on the facility's antibiotic use to the LTCF administration, medical and nursing staff, and all other healthcare providers.
2.11. Desirable
Deliver informative material on the relevance of AMS, resistance and basic local data to the residents and families.

What time interval should be adopted for reporting?

2.12. Essential
Provide antimicrobial consumption data regularly, at least every 6 months, depending on the size of the institution and quantity of prescribed
   antibiotics.

Single facilities that are part of larger corporations can liaise with each other and share services and resources. Relying on the local referring hospital or on multisectoral (i.e. operating across multiple levels of care) AMS initiatives may also be an option.

The expert panel stressed the importance of explicit policies that promote specific AMS activities in LTCFs.[7,23,24,26] When possible, single facilities are encouraged to incorporate them into local regulatory statements to share among the workforce and with representatives of residents and their families. A clear definition of roles, responsibilities and governance structure for AMS activities should always be included.[7,12,22] Understaffing and double-duty performance are frequent challenges for AMS; no guideline defines the minimum standards for dedicated time and salary support for AMS activities in the LTCF setting.

In the light of these considerations and consistent with the other settings, the expert panel deemed allocating time and specific salary support to professionals coordinating AMS activities to be essential, as a pivotal measure to guarantee sustainable implementation. Quantifying the exact amount of full-time equivalents needed for specific AMS experts was not considered helpful, as this strongly depends on the organizational structure. Consequently, it was suggested that time and resources should be quantified and allocated for specific AMS tasks (e.g. performing audit and feedback).

Efforts towards assessment of antimicrobial consumption in LTCFs are also a preliminary step for AMS implementation. Guidelines do not outline which antimicrobials should be routinely monitored, so information from AMU surveillance networks and

Table 4. Antimicrobial resistance and antimicrobial stewardship

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Which pathogens should be targeted?

3.1. Essential
Monitor methicillin-resistant *Staphylococcus aureus*, third-generation cephalosporin-resistant, carbapenem-resistant Enterobacteriaceae spp. and *Clostridioides difficile* from clinical samples.

3.2. Desirable
Identify and monitor all clinically relevant resistance patterns not included in the essential targets according to local epidemiology.

How should resistance be monitored?

3.3. Desirable
Track resistance surveillance data based on sample type from defined sites (e.g. urine), as it represents a reasonable proxy for the type of infection.

What time interval should be adopted for reporting surveillance data?

3.4. Essential
Provide resistance surveillance data at least yearly, reporting only data for which 30 or more isolates per type of sample are available.

Which stratification criteria should be adopted?

3.5. Desirable
Provide facility-specific resistance surveillance data.

Should the report be delivered to healthcare professionals other than antimicrobial stewardship team?

3.6. Essential
Deliver a report to the LTCF administration, medical and nursing staff, and all other healthcare providers.

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reports was used. Overall antibiotic consumption (i.e. aggregated data on the Anatomical Therapeutic and Chemical J01 group) is the most accessible and widely reported data. These metrics provide a general overview of AMU, but perform poorly as AMS indicators since they do not track a shift in use over time. Single agents or subclasses provide more useful information on this issue,[32] also allowing benchmarking against national standards and roughly estimating prescribing appropriateness, when combined with data on the infectious diagnosis, common microbiology isolates and antimicrobial formulary recommendations. Despite its importance, this option is labelled as desirable because it can be extremely resource consuming. As a more feasible option, allowing benchmarking and maintaining an ecological perspective, the panel recommend a bundle of three actions: (i) monitoring the most prescribed/consumed agents;[44] (ii) monitoring consumption of drugs included in the WHO Watch and Reserve categories of the AWaRe index;[45,46] and (iii) monitoring any other agent or class on the basis of local AMR epidemiology or recent outbreaks.[27] It should be noted that expressions such as 'broad-spectrum agents' and 'very-broad-spectrum agents' lack a unanimous definition. Conversely, the AWaRe index uses a universally valid categorization that allows benchmarking, improvement tracking and goal setting.[45]

Further stratification of data by indication was suggested as a desirable target. When feasible, this will help to identify areas where misuse is common, pilot future interventions and evaluate their effectiveness. Stratification of data based on the formulation/administration route was added to allow benchmarking of facilities/countries where intravenous administration is rare or not possible.[42]

Compared with hospitals, electronic prescribing systems (ePSs), automated systems for data collection and IT experts are rarely available in LTCFs. Additionally, pharmacists often work as external consultants. The panel acknowledged the difficulties associated with routine collection of reliable consumption data, proposing diversified targets based on the complexity of care provided. Cross-sectional approaches are recommended as the most accessible methods to regularly capture data on AMU. International validated protocols exist and can be easily adapted for this purpose.[18,47,48] Together with registering the overall point-prevalence of residents receiving an antibiotic, additional insight on the appropriateness of prescriptions and frequency of HAIs can be obtained within the same exercise. Even though labour intensive, this approach is widely applicable, does not depend on an ePS and requires little training for personnel, which could be external, specifically hired professionals.

Days of therapy (DOT), which has been adopted as a standard benchmarking measure in the USA, provides more accurate information on antibiotic exposure since it is not affected by dosage adjustments. Its use was labelled as 'essential' for facilities in which the complexity of care is higher and prescription patterns are similar to the hospital setting (high rates of patients requiring intravenous therapy, routine use of invasive procedures and availability of microbiological testing beyond urinary culture). Antibiotic starts (i.e. count of patients starting an antibiotic course in a defined timeframe) can be an acceptable alternative to use in less complex facilities, where assessing patient-level data is not feasible. Renal impairment, drug interactions due to polytherapy and low body weight are frequently encountered in the LCTF population, requiring dose adjustments and thus limiting the reliability of DDD-based consumption metrics. Notwithstanding this limitation, as it still represents the only available consumption metric in many facilities,[49] the panel decided to consider DDD metrics as the least preferable option.

AMU data are usually adjusted for days at risk of receiving antibiotics (accounting for facility size and variable bed occupation over time). Studies have demonstrated that the monthly census is quite stable in most LTCFs.[32] Therefore, where this stability has been verified over a relevant period, the absolute count of consumption may be sufficient. Some AMS interventions could focus on feedback to single prescribers about their prescribing performance, eventually with peer-comparison methods. In this case, the number of residents cared for, in a defined time interval, represents the most suitable denominator.

The primary goal of AMS is to improve appropriateness of prescriptions. However, the reduction of antimicrobial consumption is usually adopted as a proxy indicator because unnecessary prescriptions and excessive duration of therapy represent the highest burden of inappropriateness.[1,2,7] Lacking a universal definition, appropriateness is assessed through comparisons with local protocols, antibiotic formulary and microbiological clinical isolates. However, this aspect requires revision of each prescription and

reference standards, which are not constantly available in LTCFs, especially where GPs are responsible for prescribing antibiotics.[30,50]

Reports on AMU should be specifically designed and disseminated in a timely fashion to provide actionable data to all the professionals involved in the prescribing process. Executive leadership can use them to establish and update policies and drive resource allocation; prescribers can reflect on the impact of personal performance; nurses and other healthcare providers should also be included, as they often inform prescribers about the need for antibiotic treatment.[30,43] Supporting consumption data with information on appropriateness and educational activities will increase comprehension and possibly have an additional impact on clinical practice.[32]

Education of the general public represents a pillar in strategies to contain the AMR crisis;[51] in the LTCF setting, delivering basic information and education on appropriate prescribing (e.g. reasons for withholding antibiotics, or awaiting diagnostic results when the clinical condition is stable) to residents and their family can relieve prescribers from the social pressure sometimes exerted by patients' families, thus promoting rational prescribing and improving the patient–physician relationship.[12,30]

Facility-level AMR data are necessary to guide prescribing of empirical treatments and highlight areas for priority interventions. Moreover, the assessment of microbiological outcomes to test the efficacy of AMS interventions is strongly encouraged. However, demonstrating the impact of AMS on infection rates remains challenging due to many confounders and the prolonged follow-up

required. Although the evidence is growing in the hospital context,[52–54] to date no evidence exists on this issue in the LTCF setting, where interaction between the host environment and antibiotic use is even more complex.[11–43] In the absence of evidence and extensive experience, guidance documents provide only expert opinion-based indications on this topic. Accordingly, the panel drafted statements based on its experience and practical considerations, taking into account that LTCFs often rely on external laboratories with limited access and expertise in managing diagnostic tests. The pathogen species and susceptibility profiles to be monitored include those responsible for infectious syndromes that are frequent in the frail population and directly associated with misuse of antibiotics (e.g. *C. difficile*), and those of concern for the risk of inter-/intra-facility spread.

Microbiological data expressed as incidence rate are valuable for monitoring AMS effectiveness, detecting outbreaks and prompt IPC intervention. On the other hand, prevalence measures are more immediate in guiding empirical antibiotic therapy and monitoring specific resistant phenotypes. Prevalence data are often expressed as an intra-facility cumulative antibiogram, a practical tool providing actionable data for clinical practice, as the syndromic approach is pivotal for empirical therapy.

Guidelines from the CLSI recommend reporting a cumulative antibiogram with at least 30 isolates,[55] in order to avoid biasing AMR rates upwards or downwards due to random fluctuations. Thus, most LTCFs would be able to develop antibiograms and prevalence rates only from urine, since other kinds of samples (e.g. blood cultures) are rarely collected. Even though the sterility

Table 5. Research priorities

- **Establish criteria for ranking antibiotics**
  Rationale
  In developing an AMS programme, the team should decide which agents should be included in restrictive prescribing policies, establish rules for selective or cascade reporting of susceptibility profiles and provide de-escalation strategies. To adequately implement this decision-making, regarding the promotion/preservation of certain agents, greater understanding of their ecological impact, PK/PD properties and toxicity is needed along with a clear definition of priorities based on local epidemiology and patient characteristics. Due to wide variability in the aforementioned factors, the panel called for a more robust evidence base and innovative research design to identify universally applicable criteria to develop locally relevant antibiotic rankings.

- **Establish resistance prevalence thresholds driving AMS recommendations**
  Rationale
  Responsible prescribing should consider the local epidemiological setting. However, reliable and reproducible models forecasting coverage and associated clinical cure rates are needed to establish a precise threshold in resistance rates that should dictate a change in antimicrobial choice (i.e. widening the spectra of activity of the empirical first-line regimen or switching the agent employed in surgical and medical prophylaxis).

- **Identify optimal AMU metrics to assess the clinical impact of AMS efforts in the LTCF setting**
  Rationale
  At present, the metrics employed were derived from the hospital AMS experience and are usually selected based on data availability, limiting their direct actionability. Additional study is needed to refine them and identify the most suitable to detect a relevant correlation between consumption and resistance trends as well as clinical outcomes.

- **Define prescribing appropriateness and develop objective assessment tools**
  Rationale
  Prescribing appropriateness has still to be defined and needs further study in LTCFs. In the acute care setting, some efforts towards a shared definition have been made and practical tools for evaluation of individual prescription appropriateness have been proposed. Exploring innovative methods to estimate overall prescribing appropriateness from aggregate antimicrobial consumption data should be encouraged.

of urine in the elderly is questionable and inappropriate samples (e.g. asymptomatic bacteriuria) could introduce bias, the members agreed that these samples still represent the most feasible proxy for the most common infections.

AMR data should be periodically reported to the administration and all professionals involved in antibiotic prescription. The inclusion of nurses and other health workers can help to raise awareness about the importance of compliance with IPC practice and build a sense of professional teamwork around this topic. Additionally, the panel suggest providing an English language version of the report to foster sharing of data.

During the face-to-face meeting, additional topics needing further research emerged. The main research priorities are summarized in Table 5.

The present work has some limitations. Although a systematic literature review was not carried out, relevant documents were retrieved using a multi-step approach, starting from a reliable and complete repository of relevant guidance, reviews on the topic and a targeted literature search. However, evidence on several areas is limited, so that some of the targets were driven mainly by expert opinion. Moreover, the panel decided to keep some targets generic in order to ensure and encourage the freedom of the AMS team to customize their activities on the basis of local epidemiology and availability of resources. Experience from LMICs is hard to find, possibly due to the rarity of this kind of facility and the challenges faced by the implementation of AMS interventions in these healthcare systems.[56] Even though the experts took into account logistic constraints, applicability in these contexts is likely to be impaired.

Conclusions

Few consensus documents specifically focusing on antimicrobial stewardship in LTCFs have been published.[57,58] To the best of our knowledge, this is the first effort to overcome national or regional differences in healthcare organization by adopting a broader global perspective. Target actions are proposed with a stepwise approach coupled with constant referral to widely adopted surveillance data metrics and format; a thorough examination of possible barriers and facilitators to their everyday implementation was carried out allowing for different settings and resource availability, in order to provide suitable options to accomplish them. In conclusion, we propose a set of practical actions addressing the call for informed AMS intervention based on local epidemiology; the recommendations were formulated by prioritizing feasibility and widespread adaptability in order to provide concrete support to local teams committed to establishing or updating AMS policies in LTCFs.

Members of the ARCH working group

Ayola Akim Adegnika, Centre de Recherches Médicales de Lambaréné (CERMEL), Lambaréné, Gabon; Institut für Tropenmedizin and German Center for Infection Research, partner site Tübingen, Universitätsklinikum, Wilhelmstraße, Tübingen, Germany; Fabiana Arieti, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Nithya Babu Rajendran, Infectious Diseases, Department of Internal Medicine I, Tübingen University Hospital, Tübingen, Germany and German Centre for Infection Research (DZIF), Clinical Research Unit for healthcare associated infections, Tübingen, Germany; Julia Bielicki, Pediatric Infectious Diseases, University Children's Hospital Basel, Basel, Switzerland and Pediatric Infectious Disease Research Group, Institute for Infection and Immunity, St George's University of London, London, UK; Steffen Borrmann, Centre de Recherches Médicales de Lambaréné (CERMEL), Lambaréné, Gabon and Institut für Tropenmedizin and German Center for Infection Research, partner site Tübingen, Universitätsklinikum, Wilhelmstraße, Tübingen, Germany; Elena Carrara, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Roberto Cauda, Institute of Infectious Diseases, Fondazione Policlinico Universitario A. Gemelli IRCCS, Università Cattolica del Sacro Cuore, Rome, Italy; Monica Compri, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Giulia De Angelis, Dipartimento di Scienze Biotecnologiche di base, Cliniche Intensivologiche e Perioperatorie, Università Cattolica del Sacro Cuore, Rome, Italy; Raquel Duro, Unit for the Prevention and Control of Infection and Antimicrobial Resistance, Centro Hospitalar Universitário de São João, Alameda Prof. Hernâni Monteiro, Oporto, Portugal; Isabel Frost, Centre for Disease Dynamics, Economics & Policy, New Delhi, India and Faculty of Medicine, Department of Infectious Disease, Imperial College, London, UK; Liliana Galia, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Petra Gastmeier, German Centre for Infection Research Association (DZIF), Braunschweig Germany and Institute for Hygiene and Environmental Medicine, Charité - Universitätsmedizin Berlin, Germany, corporate member of Freie Universität Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Health; Christian Giske, Department of Clinical Microbiology, Karolinska University Hospital, Stockholm, Sweden and Department of Laboratory Medicine, Karolinska University Hospital, Stockholm, Sweden; Siri Göpel, Infectious Diseases, Department of Internal Medicine I, Tübingen University Hospital, Tübingen, Germany. German Centre for Infection Research (DZIF), Clinical Research Unit for healthcare associated infections, Tübingen, Germany; Herman Goossens, Department of Medical Microbiology, Vaccine & Infectious Disease Institute, University of Antwerp, Antwerp, Belgium; Gunnar Kahlmeter, Department of Clinical Microbiology, Växjö Central Hospital, Växjö, Sweden; Souha S. Kanj, Division of Infectious Diseases, Department of Internal medicine, and Infection Control and Prevention Program, and Antimicrobial Stewardship Program, American University of Beirut Medical Center, Beirut, Lebanon; Tomislav Kostyanev, Department of Medical Microbiology, Vaccine & Infectious Disease Institute, University of Antwerp, Antwerp, Belgium; Leonard Leibovici, Medicine E, Rabin Medical Center, Beilinson Hospital, Petah Tikva, Israel and Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel; Jean-Christophe Lucet, Infection Control Unit, Bichat-Claude Bernard Hospital, AP-HP, Paris, France and IAME, UMR 1137, DeSCID team, Université Paris Diderot, Sorbonne Paris Cité, Paris, France; Lorena López-Cerero, Microbiology and Infectious Diseases Unit, University Hospital Virgen Macarena, Sevilla, Spain; Rodolphe Mader, University of Lyon, French Agency for Food, Environmental and Occupational Health and Safety (ANSES), Laboratory of Lyon, Antimicrobial Resistance and Bacterial Virulence Unit, Lyon, France; Fulvia Mazzaferri, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Elena Mazzolini, Department of Epidemiology, Istituto Zooprofilattico Sperimentale delle Venezie, Legnaro, Padua, Italy; Marc Mendelson, Division of Infectious Diseases and HIV Medicine, Department of Medicine, University of Cape Town, Cape Town, South Africa; Rita Murri, Institute of Infectious Diseases, Fondazione Policlinico Universitario A. Gemelli IRCCS, Università Cattolica del Sacro Cuore,

Rome, Italy; Nico T. Mutters, Institute for Hygiene and Public Health, Bonn University Hospital, Bonn, Germany; Mical Paul, Diseases Institute, Rambam Health Care Campus and Ruth and Bruce Rappaport Faculty of Medicine, Technion - Israel Institute of Technology, Haifa, Israel; Maria Diletta Pezzani, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Elisabeth Presterl, European Committee on Infection Control, Basel, Switzerland and Department of Infection Control and Hospital Epidemiology, Medical University of Vienna, Vienna, Austria; Hanna Renk, University Children's Hospital Tübingen, Department of Paediatric Cardiology, Pulmology and Intensive Care Medicine, Tübingen, Germany; Oana Sandulescu, Department of Infectious Diseases I, Faculty of Medicine, Carol Davila University of Medicine and Pharmacy, Bucharest, National Institute for Infectious Diseases 'Prof. Dr Matei Balş', Bucharest, Romania; Le Huu Song, Vietnamese German Center for Medical Research, Hanoi, Vietnam and 108 Military Central Hospital, Hanoi, Vietnam; Maurizio Sanguinetti, Dipartimento di Scienze Biotecnologiche di base, Cliniche Intensivologiche e Perioperatorie, Università Cattolica del Sacro Cuore, Rome, Italy and Dipartimento di Scienze di Laboratorio e Infettivologiche, Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy; Remco Schrijver, VetEffecT, Bilthoven, The Netherlands; Luigia Scudeller, Scientific Direction of IRCCS Ca' Granda Ospedale Maggiore Policlinico di Milano, Milano, Italy; Mike Sharland, Paediatric Infectious Diseases Research Group, Institute for Infection and Immunity, St George's University of London, London, UK; Marcella Sibani, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy; Evelina Tacconelli, Infectious Diseases Section, Department of Diagnostics and Public Health, University of Verona, Verona, Italy and Infectious Diseases, Department of Internal Medicine I, Tübingen University Hospital, Tübingen, Germany and German Centre for Infection Research (DZIF), Clinical Research Unit for healthcare associated infections, Tübingen, Germany; Didem Torumkuney, International Federation of Pharmaceutical Manufacturers and Associations (IFPMA), Geneva, Switzerland; Thirumalaisamy P. Velavan, Institute of Tropical Medicine, Universitätsklinikum Tübingen, Germany and Vietnamese German Center for Medical Research, Hanoi, Vietnam and Faculty of Medicine, Duy Tan University, Da Nang, Vietnam; Andreas Voss, Department of Medical Microbiology, Radboud University Medical Centre, Nijmegen, The Netherlands.

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