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# Where we are in the fight against Antimicrobial Resistance and Healthcare-Associated Infections. The opinion of the stakeholders of the European Joint Action on Antimicrobial Resistance and Healthcare-Associated Infections (EU-JAMRAI)

**Elisa Fabbro[1*], José Arnau Sánchez[2*], María Del Pilar López Acuña[3], Hana Hukelová[3], Manuel Alcaraz Quiñonero[2], Annalisa Pantosti[4] and Luca Busani[5]**

[1]*Università degli Studi di Trieste, Trieste, Italy*
[2]*Servicio Murciano de Salud, Murcia, Spain*
[3]*Instituto Murciano de Investigación Biosanitaria, El Palmar, Murcia, Spain*
[4]*Formerly, Dipartimento Malattie Infettive, Istituto Superiore di Sanità, Rome, Italy*
[5]*Centro di Riferimento per la Medicina di Genere, Istituto Superiore di Sanità, Rome, Italy*
[*]*as first Authors equivalently*

**Abstract**
During the second European Joint Action on Antimicrobial Resistance (AMR) and Healthcare-Associated Infections (HCI) (EU-JAMRAI) annual meeting, the Evaluation Team elicited stakeholders' opinions regarding the implementation of the National Strategies and Action Plans to fight AMR and HCI, the One Health integration and the EU-JAMRAI support to the national and EU authorities in two Focus Groups. This qualitative exercise contributed to identify criticalities and possible improvements in aspects such as political priorities, legislation/legal requirements, human and financial resources, and supervision in many health sectors to ensure effective implementation of the action plans. Stakeholders pointed out at the different speed of EU member states, in particular concerning the One Health integration in the plans. Finally, the Stakeholders strongly asked the EU-JAMRAI to reinforce the integration and dissemination of the best practices and results, to help policymakers at national and European levels in defining and implementing harmonized policies and actions against AMR and HCI.

**Key words**
- antimicrobial resistance
- healthcare-associated infections
- one health
- national action plan
- grounded theory
- qualitative research

## INTRODUCTION

Antimicrobial resistance (AMR) is one of the most serious threats challenging modern medicine which have required international cooperation [1, 2]. The present crisis is linked not only to the emerging and spread of bacteria that are resistant to first and second-line antibiotics but also to the lack of new, effective antibiotics in the pipeline of research and development of the pharmaceutical industry [3]. Hence, the therapeutic options for infections due to antibiotic-resistant bacteria are very limited or non-existent jeopardizing the management of patients in surgery, oncology, intensive care, and other critical conditions. According to estimates of the European Center for Disease Prevention and Control (ECDC), based on 2015 AMR surveillance data, every year more than 600,000 antibiotic-resistant infections occur in European Union (EU) and Economic European Area (EEA) countries leading to more than 33,000 deaths and 870,000 disability-adjusted life years. The burden for the EU and EEA coun-

*Address for correspondence*: Luca Busani, Centro di Riferimento per la Medicina di Genere, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy. E-mail: luca.busani@iss.it.

tries was highest in infants and in people aged 65 years or older and was on the rise from 2007 [4]. Up to 1.1 billion Euros are expected to be spent yearly between 2015 and 2050 due to AMR across EU and EEA countries. This corresponds to about 1.8 Euros per capita per year on average, with about 4.1-4.8 Euros per capita in countries where AMR is highest, that is Italy, Malta, Luxembourg and Greece [5].

Besides this dramatic development, AMR is a complex phenomenon, including but not limited to, human medicine, veterinary medicine, animal husbandry, agriculture and the environment [6]. For this reason, international institutions unified the efforts to tackle this problem and launched several coordinated and comprehensive initiatives. In 2015 World Health Organization (WHO) endorsed a Global Action Plan (GAP) with a "One Health" (OH) approach, a multisectoral plan that includes human and animal health as well as the environment and asked member countries to elaborate a National Action Plan (NAP) following this principle [7]. "One Health" is defined as "the collaborative effort of multiple health science professions, together with their related disciplines and institutions-working locally, nationally, and globally-to attain optimal health for people, domestic animals, wildlife, plants, and our environment" [6]. It has been estimated that as many as 75% of human infectious diseases that have emerged or re- emerged in recent decades are zoonotic; that is, they originated in animals [8]. The origins of "One Health" are centuries old and are based on the mutual dependency of humans and animals and the recognition that they share not only the same environment, but also many infectious diseases [6, 9]. One of the major areas in the application of the OH approach is the AMR. Several international organizations have made important One Health contributions to the containment of antimicrobial resistance. Since the early 1990s, WHO has undertaken several expert, multidisciplinary, multisectoral consultations and advisory groups, compiled considerable objective evidence of and scientific opinion about the human health impacts of antimicrobial use in animals, and formulated wide-ranging recommendations applicable to all stakeholders (e.g., regulatory authorities, pharmaceutical industry, animal production industry, veterinarians, farmers, public health, consumers) [10].

Since 2016 the Tripartite WHO, the Food and Agriculture Organization (FAO) and the World Organization for Animal Health (OIE) have monitored the progress of the countries on AMR policies and the implementation of the NAP [11].

In June 2017, the European Commission adopted the "EU One Health Action Plan against AMR "and proposed the creation of a "One Health" network in Europe [12, 13]. It is essential that OH teams work together from the early phase of a research program in order to gain a comprehensive view of the problems, generate new hypotheses, and innovate approaches based on transdisciplinary methods [13].

In parallel with the problem of AMR, the issue of Healthcare Associated Infections (HAI) cannot be considered separately from AMR. In fact, both control of AMR and infection prevention and control strategies for HAI are based on the same pillars: i) prudent use of antibiotics ii) appropriate tools for monitoring and surveillance and iii) accurate diagnostic tests to decide on the right therapy.

In 2017, the 3rd Health Programme of the European Union and the participating countries co-funded the European Joint Action on Antimicrobial Resistance and Healthcare-Associated Infections (EU-JAMRAI) with 3-year duration [14].

Within the second Annual Meeting of EU-JAMRAI, held on 16-17 September 2019 at the Italian National Institute of Health (ISS), Rome, Italy, the2nd Stakeholder Forum took place to discuss the EU-JAMRAI progress and the emerging issue related to AMR and HAI. In this context, the aim of this study was to analyze the Stakeholders´ opinion about the implementation of NAP for Antimicrobial Resistance and Healthcare-Associated Infections, the OH approach of these plans and the EU-JAMRAI role in supporting the actions at country level.

## MATERIALS AND METHODS

### *Study design*

The qualitative research method was used since it is considered the most appropriate to identify and explore the phenomenon under study from the participants´ perspective. It was guided by a constructivist approach and elements of grounded theory which provide the methodology to develop a rich theoretical understanding of the people's perception [15]. This is a social scientific vision influenced by social constructivism and symbolic interactionism, and whose objective is an interpretative understanding of the participants´ multiple perspectives and meanings. The study design was defined taking into account the stakeholders' background and representativeness.

The focus group (FG) method was chosen because of its effectiveness in exploring the meaning of relevant concepts taking place in the healthcare context [16]. Two FGs were defined, the first to explore AMR and HAI and the second AMR and antimicrobial use in humans and animals.

To facilitate the engagement of the stakeholders in the discussion and to ensure that all the relevant topics were explored, for each FG an open-ended questions guide *(Supplementary Material available online)* was prepared to explore dimensions of the study related to the implementation of OH National Strategies and NAPs for AMR, Prevention and control of HAI, Antimicrobials use in humans and animals, and Implementation of antimicrobial stewardship.

The list of questions for the participants to explore each dimension is shown in *Table 1*.

### *Sample and setting*

The recruitment process took place at the 2nd Stakeholder Forum that took place at ISS in September 2019. The European stakeholders involved in EU-JAMRAI represent the scenario. From the list of those who registered for the meeting a purposive sampling (deliberate selection to maximize variability and mini-

**Table 1**
List of questions asked to the participants of the focus groups

| |
|---|
| **Dimension 1. Implementation of One Health National Strategies and National Action Plans for AMR** |
| 1. According to your knowledge, what are the weaknesses that can jeopardize the effectiveness of the national strategies to contain or reduce AMR? |
| 2. According to your knowledge, what difficulties do you envisage in carrying out the implementation of One Health National Strategies and National Action Plans? |
| 3. Concerning the support to One Health National Strategies and National Action Plans for AMR, what advice/suggestions would you give to the EU-JAMRAI project team that can be considered in the next year of activities? |
| **Dimension 2. Prevention and Implementation of HAI** |
| 1. According to your knowledge, what are the weaknesses that can jeopardize the effectiveness of the national strategies to contain or reduce HAI and related AMR? |
| 2. According to your knowledge, what difficulties do you envisage in carrying out improvement actions in the prevention of HAI and their implementation? |
| 3. Concerning the prevention of HAI and their implementation, what advice/suggestions would you give to the E-JAMRAI project team that can be considered in the next year of activities? |
| **Dimension 3. Antimicrobials use in humans and animals** |
| 1. According to your knowledge, what are the weaknesses of the present monitoring and surveillance of antibiotic use in humans/ in animals? |
| 2. What strengths do you identify regarding the present monitoring and surveillance of antibiotic use in humans/in animals? |
| 3. Concerning the appropriate use of antimicrobials in humans/animals, what advice/suggestions would you give to the EU-JAMRAI project team that can be considered in the next year of activities? |

mize bias response) was used to invite the participants to the FGs. Nine stakeholders accepted the invitation and attended the two FGs. The demographics for the theoretical sample are reported in *Table 2*.

The FGs were carried out in two separate rooms of ISS and lasted about 60 minutes. Each FG was conducted by two members of the WP3 Evaluation Team of EU-JAMRAI, who had no previous contact with the participants and were experts in the management of qualitative data collection techniques.

### *Data collection and analysis*

Data analysis took place during autumn 2019 and spring 2020. Following the recommendations of Strauss and Corbin [16], the analysis process followed the open, axial and integration coding. In the open coding, a preliminary code closely fitting with the data was given to each semantic unit of data (line-by-line coding). In the axial coding, the data were grouped aiming to obtain a clearer and more complete explanation about the phenomenon. The grouping was defined by a systematized analytical process of comparison and connection among the different categories [15]. In the integration phase, the categories and subcategories were compared, analyzed and refined, and a core category of this grounded theory related to the Stakeholder´s perception about the criticalities for an appropriate implementation of National Strategies and NAPs, the OH integration into the NAPs, and the support from the EU-JAMRAI emerged. During data analysis, memos were used to document ideas about the coding process and insights into the relationship among codes, concepts and categories [16, 17].

The latest were the areas of knowledge from which, and by theoretical saturation, the central category emerged: identifying the criticalities of the OH National Strategies and NAPs for AMR and EU-JAMRAI contribution from the stakeholders´ perception. Regarding criteria for rigor, the recommendations of Guba and Lincoln were followed to set strategies to ensure validity and reliability [17]. In order to ensure credibility, the results were illustrated with textual fragments from the transcripts of the

**Table 2**
Demographics and methods of data collection for the theoretical sample

| Topic | Method of data collection | Gender | Age | Organisation |
|---|---|---|---|---|
| 1. Implementation of One Health National Strategies and National Action Plans for AMR and Policies for Prevention of Health-Care-Associated Infections and their Implementation<br>2. Appropriate use of antimicrobials in human and animals | Focus Group | 3 Females<br>6 Males | Range 22-65 years | • Institutional and research organizations<br>• Civil society-healthcare professionals<br>• Joint Programming Initiative on Antimicrobial Resistance Virtual Research Institute (JPIAMR-VRI) |

stakeholder's discussion. In addition to the recording, the evaluation team members, responsible for data analysis, kept a reflective diary of the transcriptions to ensure reliability of the results. Finally, the use of the Maxqda 10 Software (VERBI Software, Berlin, Germany), as operational support throughout the investigation process, allowed ensuring the auditability of the project. The research followed the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines [18].

### *Ethics, data protection and confidentiality*

The attendees agreed to participate voluntarily, after receiving verbal and written information about the FG and their contribution to it. Written informed consent was obtained from each participant and included permission for the voice recording and verbatim transcription of the FG discussions and the use of the collected information for the purpose of the analysis and reporting, guaranteeing confidentiality. Participants were informed of their rights, and that they could leave the FG at any time if they wished [19].

## RESULTS

The analysis of the data indicated three main levels/categories of drivers that have a direct negative impact on the implementation of OH National Strategy into NAP, namely: 1) macro level-political and governmental actions; 2) medium level-community hospital organization and infrastructures; 3) micro level-health professionals and population awareness and engagement. A fourth category, 4) synergies to ensure the success of the implementation, lists some specific actions identified by the stakeholders to improve the NAPs (as described in the chapters below).

The main categories emerged from the study were further divided into subcategories and the outline of the results is presented in *Figure 1*.

## POLITICAL AND GOVERNMENTAL ACTIONS

### *Lack of effective central actions by the governments*

The participants complained about a limited support for the HAI and AMR programs with need to improve political commitment and actions by the central governments of the countries. The stakeholders perceived that central governments should actively support the initiatives needed to control and prevent HAI and AMR; otherwise, the NAP implementation should not be realistic.

"(…) there is a lack of central actions against this problem; it is not a problem that can be solved by a

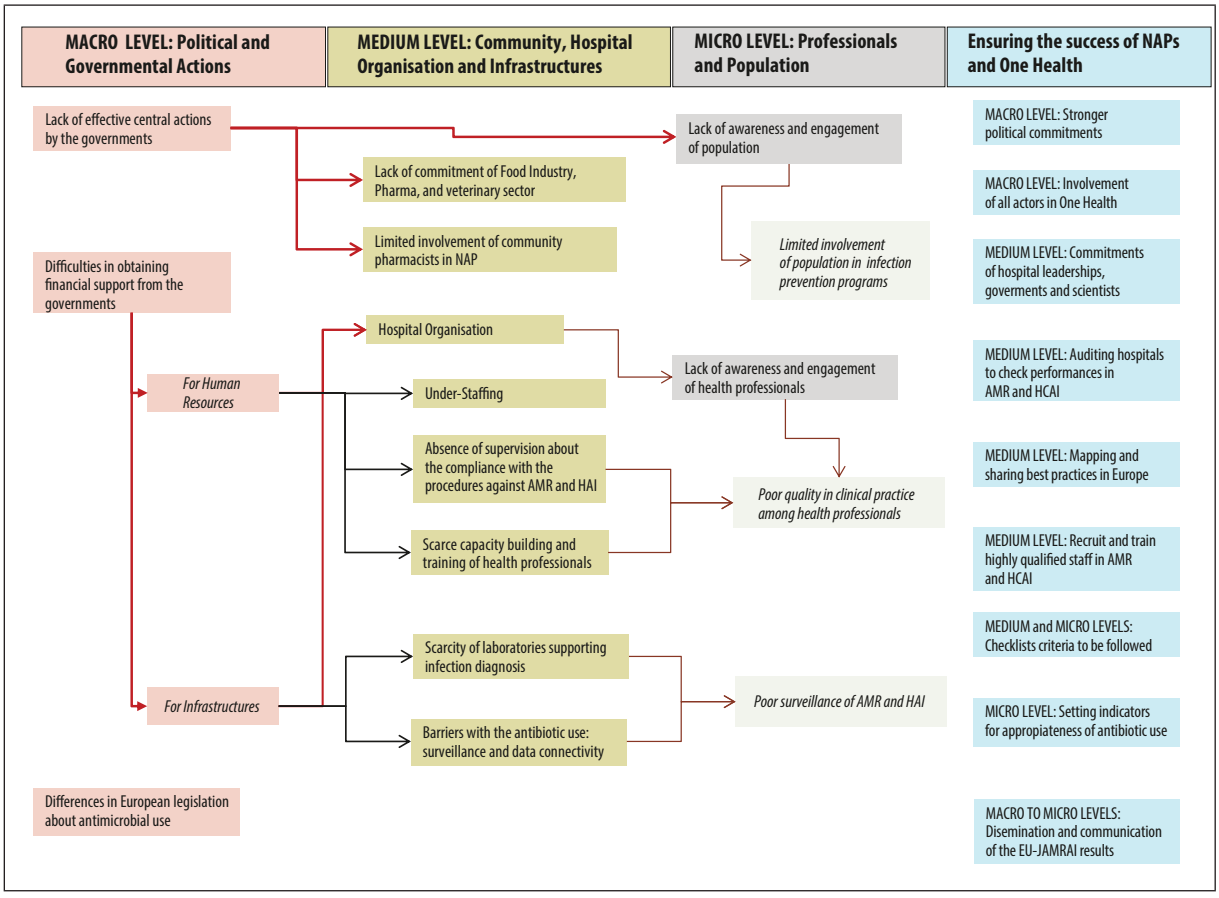


**Figure 1**
Description and interaction of the three main levels/categories of drivers with direct negative impact and some specific actions identified by the stakeholders on the implementation of One Health National Strategy into the National action plans against antimicrobial resistance and healthcare associated infections.

single hospital; wide national programs should be carried out." (FG1-Stakeholder -3).

"(…) and they should decide to implement national programs focused on strong political actions to reduce this problem. This is not only a problem of the single worker, it is a problem of the hospitals, regions and countries (…)" (FG1-Stakeholder -4).

***Difficulties in obtaining financial support from the governments***

The lack of specific financial support to hospitals by the governments would have a negative impact on the OH Strategy not providing enough resources and infrastructures needed for the appropriate implementation of NAP for AMR. Some stakeholders stressed that the lack of financing which should have been aimed at providing resources and infrastructures to support infection prevention negatively impacted on both human and animal health. The participants believed that such limitations contribute to jeopardize the process of the NAP implementation.

"The lack of financing, let's say, in order to provide the needed tools and structures to prevent those HAI" (FG1-Stakeholder -1).

***Differences in European legislation about antimicrobial use***

Stakeholders highlighted the importance of developing an appropriate legislation about the use of antibiotics. In human medicine, there is insufficient legislation regulating antibiotic use, as opposed to the veterinary sector. As a result of that, the veterinary sector has achieved great progress, especially because the use of antibiotics was really massive in some countries. One of the key points that should be considered at country level is the implementation of the legislation.

"(…) in veterinary, immense progress, very impressive", (FG2-Stakeholder-3).

"(…) all of the things we have identified in the last years are in the legislation (…) let's first implement the legislation (….) so we can start properly in January 2022" (FG2-Stakeholder-1).

All the critical issues concerning AMR, antimicrobials and their appropriate use in the veterinary sectors are regulated by the new Veterinary Medicine Regulation (Regulation EU 2019/6) that will come into force in January 2022. The priority antibiotics indicated by WHO are of restricted use in the veterinary fields.

"In animals, one of the key points is the implementation of the legislation. All the critical issues concerning AMR, antimicrobials and their appropriate use in the veterinary sectors are put in the legislation (FG2-Stakeholder-1)."

"(…) all of the things we have identified in the last years are in the legislation which has been adopted last year [note from the authors: Regulation (EU) 2019/6 of the European Parliament and of the Council of 11 December 2018 on veterinary medicinal products and repealing Directive 2001/82/EC that will came into force January 1st, 2022], so we are in a phase where there is a lot of work to do because of the new requirements (FG2-Stakeholder-1).

## COMMUNITY, HOSPITAL ORGANIZATION AND INFRASTRUCTURES

### *Community*

*Insufficient commitment of Food Industry, Pharma, and veterinary sector*

Participants believed that there exists a scarcity of commitment from sectors related to health, such as the agriculture and farming sector and the Food and Pharmaceutical Industries. This limited engagement hampers an effective fight against AMR within the OH context.

"And the final thing is lack of engagement of other sectors; we are not talking only about the health sector, we are talking about food industry, we are talking about pharma sector, veterinary sector and those that are related to health, because AMR is related to multiple other sectors so horizontal approach is being used more." (FG1-Stakeholder-5).

*Limited involvement of community pharmacists in NAP*

Stakeholders pointed out the poor involvement of the pharmacists in writing and implementing the guidelines for the appropriate use of antibiotics in the NAPs in most European countries, as opposed to the health professionals. Stakeholders believed that since the great majority of antimicrobials in human medicine is sold in the community, community pharmacists should be more integrated in the NAP strategies for appropriate antimicrobial use.

"(…) when it comes to guidelines on appropriate use or antimicrobial stewardship for healthcare professionals, we, as community pharmacists, see that in most EU countries community pharmacists are not structurally involved in NAPs, guidelines or strategies (…)" (FG2–Stakeholder-4).

### *Hospital organisation*

*Inadequate supervision about the compliance with the procedures against AMR and HAI*

Participants stressed that hospital managers should make health professionals aware of the existence of protocols to prevent and control AMR and HAI, as well as to supervise the compliance to the protocols inside hospitals.

"(…) the directors at the hospital should alert that there is a procedure that professionals should follow, and this information has to be posted. That's probably something that could affect, because if you leave the organization without the piece of paper it doesn't work (…)" (FG1-Stakeholder-3).

*Need to improve capacity building and training of health professionals*

The participants considered important to promote the development of capacities in hospital organizations, to support the training and career development in HAI and AMR control. The stakeholders highlighted the training needs for health professionals to acquire awareness and responsibility about the OH Strategy, to define and achieve common goals on HAI and AMR prevention and control. This aspect is of paramount importance to address infection control in hospital setting.

"For me, I focus more on capacity building of different players, let's say (…) it could make that professionals are more effective, are more responsible and are more aware of the problem. (…)" (FG1-Stakeholder-2).

*Under-staffing*

Under-staffing has been considered a barrier to successfully implement infection control programs in hospital settings. The main reasons that were mentioned by participants were: scarce hospital policies to provide dedicated staff to this program, and a shortage of qualified professionals to address the infection control programs in clinical practice.

"Besides, the problem of lack of staff, under-staffing, and also the problem of education, having proper, let's say, personal working or dedicated to ensure the prevention of those infections". (FG1-Stakeholder-2).

***Infrastructures***

*Scarcity of laboratories supporting infection diagnosis*

According to the participants, most antibiotic prescriptions are based on empirical knowledge or personal experience, without the support of diagnostic tests or microbiology laboratories. Such circumstances prevent the practitioner from making an accurate diagnosis of the infection, which in turn will affect the appropriateness of prevention measures and antibiotic treatment.

"I am always surprised that doctors for humans very often prescribe what we consider critical antibiotics without any sensitivity testing. It is not allowed in my profession". (FG2-Stakeholder-3).

"(…) And also the problem of the logistic, or not adequate logistics and materials and structures in order to ensure appropriate prevention of those infections". (FG1-Stakeholder-4).

*Barriers with the antibiotic use: surveillance and data connectivity*

The stakeholders perceived that a scarcity of computerized data recording system limit the development of adequate surveillance and monitoring of antibiotic use in both medical and veterinary sectors. Although such system is present in some European countries, its implementation in all EU countries is complex and not achievable in a short time, due to the system complexity and contextual differences among countries.

"(…) we (Europe) are one but countries go at different speeds (…)" "It is good to have computer data (for prescriptions) (…), but there are countries where they keep records in a booklet or not even that". "(…) It is different if you have a good system for all EU" (FG2-Stakeholder-2).

"(Lack of) Infrastructures for appropriate surveillance and monitoring are key barriers for comparable results across EU countries" (FG2-Stakeholder-2).

Some participants highlighted that in both human and animal medicine, monitoring the prescription could give information also on the impact of switching from one antibiotic to another in terms of outcome and appropriateness. A correct antibiotic stewardship should be based on the knowledge of the antibiotic resistance at the local level (hospital or farm).

"What happens, what are the consequences if you change prescription or you switch from one antibiotic to another, for instance for UTI" (FG2- Stakeholder -1).

"I need to know what is happening [regarding antimicrobial resistance] in my area for the species I am treating". (FG2-Stakeholder-4).

The stakeholders perceived that a central database would be crucial in order to ensure data availability and usability. Monitoring of the use of antibiotics should not be evaluated separately from other information, such as AMR surveillance. It is important to link the use of the antimicrobials with the level of AMR and the outcomes of patients with infections due to AMR pathogens.

"(…) concerning AMR and antimicrobial usage surveillance, a thing that would help us a lot will be more granular data, for example patient-level usage linked to the outcome and linked to laboratory data (…)". (FG2-Stakeholder-1).

***Health professionals and population***

*Dearth of awareness and engagement of health professionals and population*

Most participants asserted that there is poor awareness and engagement in both professionals and general population due to limited knowledge about antibiotic resistance. This leads to insufficient collaboration and participation in health programs aimed at fighting AMR and HAI and, consequently, less success of these programs in the hospital and community settings.

"When we are working in those Action Plans, usually the lack of engagement or knowledge of professionals can contribute a lot in the non-success of these programs at the hospital level or in the clinical level in general". (FG1-Stakeholder-5).

"(…) Lack of awareness and engagement of the general population, if you want to implement a program it should not be only vertically; one thing to take in consideration is the collaboration of patients". (FG1-Stakeholder-2).

Some stakeholders pointed out that the scarcity of knowledge related to HAI among health professionals contributes to inadequate quality in clinical practice, making it difficult to manage the infections in the hospital.

"In my opinion, I think that lack of knowledge about HAI in healthcare professionals, is a challenge to focus on, there is bad practices inside hospitals, maybe it can contribute to these infections". (FG1-Stakeholder-3).

## ENSURING THE SUCCESS OF THE OH INTO NAP IMPLEMENTATION

Stakeholders asserted the importance of the political level to support the implementation of OH Strategy in NAPs against AMR. They pointed out at the differences among MSs in terms of speed, infrastructures, resources and capacity in the implementation of the recommendations and the action plans, and these differences result in severe limitations for the implementation of integrated surveillance that involves both medical and veterinary sectors.

"One health approach is becoming more and more considered in the EU. Initiatives in MSs are ongoing

to make better use of data from the different sectors and try to integrate analyses to help understanding the phenomenon of AMR, but comparability and availability of data across sectors is still an issue". (FG2-Stakeholder-2).

According to the participants, the focus of the EU-JAMRAI should be on the following aspects: i) strengthening the political commitment and the governmental engagement, to ensure support and resources to the national and international initiatives against AMR and HAI, ii) committing hospital leaderships, governments and scientists to define common criteria and checklists to address the criticalities at hospital level; iii) making audit within hospitals, iv) mapping existing best practices in European countries in order to facilitate their sharing; v) checklist criteria to be followed, vi) highly qualified staff in AMR and HCAI, vii) involving all actors in OH Strategy, viii) defining recognized general standards for appropriateness of antibiotic use and setting indicators for its evaluation, ix) disseminating the EU-JAMRAI results and communication at high national levels.

"We need also a strong political commitment, because we a notice this initiative really not connected with political level, not just policy but political level (…)". (FG1-Stakeholder-5).

"(…) to share a checklist with a list of criteria to be followed and respected by every hospital". (FG1-Stakeholder-4).

"(…) to make audit within the hospitals…"(FG1. Stakeholder -5).

"What I would suggest is to have a clear idea on the practices from all the European Countries participating to the JAMRAI about practices and procedures to prevent HAI, education and training of the staff involved, so we can share best practice" (FG1- Stakeholder - 1).

"The need for a nation-wide program, not a single program based on hospitals. I want to see taking account of veterinarians, people, microbiologists, pharmacies, and industries (…)". (FG2- Stakeholder 2).

"(…) appropriate use can only be measured by own standards". (FG2-Stakeholder-2).

"(…) to reinforce the JAMRAI... to really work a lot on the dissemination of the results ... so many interesting things have been done (…) but really the results should be communicated to everyone." (FG1-Stakeholder-1).

## DISCUSSION

The debate generated inside the FGs provided valuable information derived from direct experiences, beliefs, perceptions and attitudes of the involved stakeholders in relation to the topics under study.

Although the stakeholders FGs consisted of a small number of participants, they proved to be very helpful in pointing out areas for improvements of the NAPs, considering different levels of intervention: government, hospitals and individuals. To the best of our knowledge, in the literature there are very few studies that provide enough qualitative research data on AMR at EU level [20-22]. Moreover, having stakeholders involved from different sectors and backgrounds, enriched the discussion with examples and comparisons across sectors on how the different issues related to the NAPs and the fight against AMR and HCI have been addressed.

At governmental level, the main barriers reported during the discussion were insufficient central actions and dedicated resources to combat HAI and AMR. Although national efforts have grown steadily over the last two decades, what has been done so far does not match the recommended scale of actions, and progress with developing NAPs has been limited in many countries. At national level, the public health system organization can be a barrier, in case of shared powers between the central (Ministry) and the local authorities (Regions) and high differences in the regional/local capacities; hence the actions can result disjointed. Similar observations were found in several other studies [2, 23, 24]. As expected, both focus groups considered the insufficiency of financial, human and IT resources is a serious constrain. In particular, shortage of specialists in HAI and AMR, lack of engagement of health professionals were pointed out. Specific staff related issues, like scarce capacity building, staff turnover and new staff training, work overload and lack of incentives were also identified as barriers in a qualitative study conducted at a hospital in India [24]. Concerning IT, the limited capacity of collection and integration on a routine basis of AMR surveillance and antimicrobials use data was considered a limitation to the assessment, implementation and monitoring of the actions taken by national government. Data availability including diagnostic and molecular data, links between people and systems, which include organization, information technology and systems was pointed out also by other authors as critical issue [3, 25, 26]. Other studies pointed out the need of interactions between people and systems, which include organization, technology and systems [24]. All these aspects have been also shown in our research.

Between the medical and veterinary sectors, the stakeholders pointed out at the difference in legal provisions provided by the EU Commission that require AMR surveillance and antibiotics prudent use in animal health and food safety enforced at national level but nothing similar is so far requested for the medical sector. This difference weakens the power of the central governments to push forward and implement the actions detailed in the NAPs, in particular in the medical sector, since they cannot refer to any strong and harmonized international legal basis.

Another criticality pointed out by the focus group was the poor OH component of the NAPs, and the need to strengthen this approach to ensure integration and synergies among sectors. In particular, the commitment of the national authorities, the involvement of the main stakeholders and the development of reference criteria and standards were identified as main gaps.

The limitation of the FG results was mainly related to the representativeness of the stakeholders. Although all of them were representative of EU or international organizations or associations, some were also national experts or professionals, and it is possible that their opinions were sometimes driven by their national/local experience. This could have resulted in describing some specific situations, but the overall value of the exercise

was not reduced, and most of the comments were generalizable.

The information collected were analyzed to provide recommendations on how to improve capacity at local and national level. Policy briefs that addressed the unmet needs of resources, awareness, training, and reference standards at EU level to ensure proper national capacity were released by the experts. However, the One Health vision and approach, although promoted by EU-JAMRAI, was only partly addressed, due to the complexity and the heterogenicity of the situations found at national and local level.

## CONCLUSIONS

The FGs proved to be helpful identifying the main criticalities and the improvements needed to the NAPs. The main criticalities discussed were in human and financial resources, political priority, legislation/legal requirements, and supervision in many health sectors. The FGs strongly asked the JA to improve integration, dissemination and communication of the best practices and results, to help policies and actions at national, hospital and community level.

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***Authors' contributions***

JAS and EF equivalently contributed to the manuscript; JAS with the analyses of the data and the methodology; EF with the participation in the focus groups, data collection and data extraction from the recordings. Both wrote and revised the drafts. MPLA promoted and supervised the work. HH and MA contributed in data collection and revised the drafts.

AP and LB provided information on the general aspects of the topic AP for public health and LB for animal health aspects, both contributed writing part of the introduction and discussion and revised the drafts.

***Conflict of interest statement***

None declared.

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