Evaluating integrated surveillance of antimicrobial resistance: experiences from use of three evaluation tools

Nielsen, Liza Rosenbaum; Alban, Lis; Ellis-Iversen, Johanne; Mintiens, Koen; Sandberg, Marianne

Published in:
Clinical Microbiology and Infection

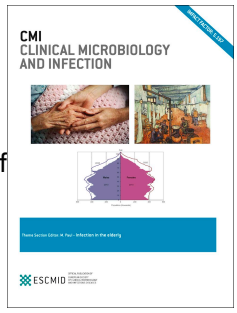
Link to article, DOI:
10.1016/j.cmi.2020.03.015

Publication date:
2020

Document Version
Peer reviewed version

Citation (APA):
Nielsen, L. R., Alban, L., Ellis-Iversen, J., Mintiens, K., & Sandberg, M. (2020). Evaluating integrated surveillance of antimicrobial resistance: experiences from use of three evaluation tools. *Clinical Microbiology and Infection*, *26*(12), 1606-1611. https://doi.org/10.1016/j.cmi.2020.03.015

Journal Pre-proof



Evaluating integrated surveillance of antimicrobial resistance: experiences from use of three evaluation tools

Liza Rosenbaum Nielsen, Lis Alban, Johanne Ellis-Iversen, Koen Mintiens, Marianne Sandberg

PII: S1198-743X(20)30159-2

DOI: https://doi.org/10.1016/j.cmi.2020.03.015

Reference: CMI 1977

To appear in: *Clinical Microbiology and Infection*

Received Date: 12 November 2019

Revised Date: 24 February 2020

Accepted Date: 13 March 2020

Please cite this article as: Nielsen LR, Alban L, Ellis-Iversen J, Mintiens K, Sandberg M, Evaluating integrated surveillance of antimicrobial resistance: experiences from use of three evaluation tools, *Clinical Microbiology and Infection*, https://doi.org/10.1016/j.cmi.2020.03.015.

Evaluating integrated surveillance of antimicrobial resistance: experiences from use of three evaluation tools

Liza Rosenbaum Nielsen[1], Lis Alban[1,2], Johanne Ellis-Iversen[3], Koen Mintiens[4], Marianne Sandberg[2]

[1]Department of Veterinary and Animal Sciences, University of Copenhagen, Frederiksberg, Denmark

[2]Department for Food Safety, Veterinary Issues and Risk Analysis, Danish Agriculture & Food Council, Copenhagen, Denmark

[3]National Food Institute, Danish Technical University, Lyngby, Denmark

[4]Food and Agriculture Organization of the United Nations, Rome, Italy

Corresponding Author: Liza Rosenbaum Nielsen

E-mail: liza@sund.ku.dk

ABSTRACT

Background - Integrated antimicrobial resistance (AMR) surveillance programmes require regular evaluation to ensure they are fit-for-purpose and that all actors understand their responsibilities. This will strengthen their relevance for the clinical setting which depends heavily on continued access to effective treatment options. Several evaluation tools addressing different surveillance aspects are available.

Objectives - To understand the strengths and weaknesses of three evaluation tools, and to improve guidance on how to choose a fit-for-purpose tool.

Sources - Three tools were assessed: 1) AMR-PMP - The Progressive Management Pathway tool on AMR developed by the Food and Agriculture Organization (FAO) of United Nations, 2) NEOH developed by the EU COST Action 'Network for Evaluation of One Health', and 3) SURVTOOLS developed in an FP7-EU project 'RISKSUR'. Each tool was assessed with regard to contents, required evaluation processes including stakeholder engagement and resource demands, integration coverage across relevant sectors and applicability. They were compared using a pre-defined scoring scheme and a Strengths-Weaknesses-Opportunities-Threats (SWOT)-like format for commenting.

Content - All three tools address multiple decision-making levels and aspects of stakeholder engagement. NEOH focuses on system features, learning, sharing, leadership and infrastructure, and requires a description of the underlying system in which AMR develops. AMR-PMP focuses on four areas: Awareness, evidence, governance and practices and assesses the implementation degree of pre-chosen aspects within these areas. This requires less of the evaluator, but warrants participation of multiple stakeholders. SURVTOOL provides information and references on how to evaluate effectiveness, process and comprehensiveness of surveillance programmes. All three tools

require veterinary epidemiology expertise and varying levels of evaluation methodology training to use appropriately.

Implications - The tools covered AMR surveillance and One Health aspects to varying degrees. This study provides guidance on aspects to consider when choosing between available tools and embarking on an evaluation of integrated surveillance.

Keywords:

Evaluation; Tools; Integrated; Surveillance; Antimicrobial resistance;

1. INTRODUCTION

A surveillance programme or activity might be adequate and effective at its initial design and implementation. However, the context changes over time and new discoveries may have been made within laboratory or data capture methods. Similarly, changes in disease epidemiology, demography or clinical treatment practices and opportunities may have happened. Additionally, resources may diminish and priorities change making cost-effectiveness more important. In other words, the surveillance programme may no longer be fit-for-purpose.

Over the last decade, several tools have emerged with the aim to evaluate surveillance programmes, recently with a focus on surveillance of antimicrobial resistance (AMR) and integrated activities and interventions such as surveillance of antimicrobial use (AMU) (Bordier et al., 2018). Some evaluation tools focus mostly on technical aspects, whereas others build on process and system evaluation (Calba et al., 2015). The latter may include institutional relations, leadership, cross-

sectorial collaborative working methods, stakeholder engagement, infrastructure as well as systems thinking. These aspects are becoming increasingly important in the AMR-arena as there are growing concerns about the over- and misuse of antimicrobials in all relevant sectors (humans, animals and the environment), which may eventually make current treatments of choice ineffective. Moreover, cost-effectiveness in surveillance needs to be considered, as economic constraints are an inherent part of most programmes.

The variety in foci of surveillance evaluation tools emphasises the importance of selecting an appropriate tool for the purpose of the evaluation not to end up confusing or misleading actors, stakeholders and decision makers. As a first step in a process to develop improved guidance on how to choose between evaluation tools, we provide an overview of what three available tools offer and require from the evaluators.

2. MATERIALS AND METHODS

2.1. Description of the AMR-PMP tool

The Progressive Management Pathway for AMR (AMR-PMP), published in November 2019[1], has been designed by FAO as a management approach, which provides guidance to countries for operationalizing their national action plans (NAP) for AMR step-by-step. AMR-PMP relates to all aspects of agriculture and food production in a One Health (OH) context (meaning e.g. that it takes into account the relevance of AMU across different sectors that AMR may spread between). The structure is based on four focus areas: Awareness, Evidence, Governance and Practices. By use of AMR-PMP, countries and individual sectors can evaluate their current status and document areas working well. They can also identify areas in need of improvements. AMR-PMP describes

[1] http://www.fao.org/antimicrobial-resistance/resources/tools/fao-pmp-amr/en/

activities to apply in each focus area in a progressive manner, whereby a country can be in one of four levels. Specific activities, achievements and key performance indicators listed in the tool, guide the user through the evaluation. The country can select or deselect any activity according to relevance and in agreement with the NAP. Hence, a country does not have to fulfil all activities in Level 1 before continuing to Level 2, 3 or 4. Logic is followed for several of the questions listed, e.g. planning an activity is related to Level 1, whereas undertaking the activity is associated with a higher level. Likewise, activities undertaken only locally are associated with Level 1, whereas regional activities are associated with Level 2 or 3, and national activities with Level 4. The tool provides a dashboard, showing the progress made for each focus area. In the version from July 2019, there was one part for country-level and another for a specific livestock sector. A reference is made to the 'ATLASS' tool by use of which the laboratory part of AMR surveillance can be evaluated (FAO, 2019).

2.2. Description of the NEOH tool

The NEOH evaluation tool was a result of the EU COST Action "Network for Evaluation of One Health" (Rüegg et al., 2017). It was created for complex OH-issues and builds on systems theory. For evaluation of single initiatives, it consists of three elements to address: (1) description of the initiative and its context (the underlying system within which the initiative operates), (2) description of the theory of change behind the initiative including assessment of expected and unexpected outcomes, and (3) process evaluation of operational and supporting infrastructures (the "OH-ness"). The evaluation approach combines a descriptive and qualitative assessment with a semi-quantitative scoring for the evaluation of the degree and structural balance of "OH-ness" summarised in an OH-index and OH-ratio, and metrics for different multi-criteria-analysis outcomes (Rüegg et al., 2018a). A Microsoft Excel template is available through open-access as a specific tool for the OH-ness evaluation in which web-diagrams illustrate distribution of scores. The tool is designed for

evaluators trained in the transdisciplinary approach and comes with a book providing theory and inspiration for the evaluation process (Rüegg et al., 2018b).

2.3. Description of SURVTOOLS

SURVTOOLS was originally developed in the EU-funded project RISKSUR (Peyre et al., 2019). It consists of three parts, where the two first cover the context for the surveillance programme of interest and must be filled in before it is possible to conduct the evaluation. After defining the surveillance programme, the "EVA tool" (part of the SURVTOOLS) can be used on each of the described components of the surveillance programme. The user is guided through a structured, four-step process to develop an evaluation plan: (1) Describe evaluation context, (2) Select evaluation question(s), (3) Select evaluation method(s), and (4) Review summary of the evaluation protocol. The evaluation plan provides additional information and guidance on how to perform the evaluation and how to report on the evaluation outputs. The tool supports the user in selecting evaluation questions. Information on how to conduct the technical evaluation of the performance of the surveillance components and more complex evaluation tasks are provided as scientific references. Surveillance attributes such as surveillance system organization, acceptability and engagement (awareness), simplicity, sustainability, robustness and sustainability of the surveillance, flexibility and compatibility can be chosen. A figure is provided to illustrate the degree of complexity related to the evaluation elements. SURVTOOLS has a link to statistical tools and epidemiology tools as well as a WIKI, where information can be found about use of the tool and definition of key terms used. For more information, please see: https://survtools.org.

2.4. Assessment of the tools Each tool was reviewed, and during three Skype-meetings, two in-person meetings in Denmark and three international consortium workshops (1-2 days each) it was discussed what would be required to apply each of these tools for an evaluation of integrated AMR

surveillance. Some tools were trialled on a part of the Danish Integrated AMR Surveillance Programme (DANMAP, 2018) for better understanding and practical experience. The experiences were combined with general expertise in evaluation of surveillance activities, OH initiatives and knowledge of the DANMAP.

2.5. Criteria for scoring strengths and weaknesses

A scoring scheme was developed in the core part of a project called 'CoEval-AMR'[2] to assess how the individual tools evaluated a surveillance system. The scheme evaluated the ability of the tools to address different aspects of surveillance programmes captured through questions using scores: where 1 = not satisfactory, 2 = major improvements needed, 3 = some improvements needed, 4 = satisfactory (Table 1).

The user experiences were assessed using a Strengths-Weaknesses-Opportunities-Threats (SWOT)-like approach. After the investigation and trial of each tool, we answered the following questions: 1) things that I really liked about this tool or that it is good at covering , 2)things I struggled with, 3) things people should be aware of when using this tool, and 4) things that this tool is not covering or not good at covering. The answers were captured in free text.

3. RESULTS AND DISCUSSION

3.1. The AMR-PMP TOOL

The AMR-PMP tool went beyond surveillance for AMR and it further assessed surveillance for residues of antimicrobials in food. It also included questions about national awareness campaigns. Hence, it was deemed necessary to have knowledge about a larger part of the programme to apply

[2] https://coevalamr.fp7-risksur.eu/

the tool. An example of evaluation results using AMR-PMP can be found in Fig. 1 displaying the dashboard with the four focus areas. The figure shows - as expected - that a country may have completed actions at a higher level without completing it at lower levels.

In general, the AMR-PMP was perceived as user-friendly and meeting the evaluation needs. It would improve from more details on how to evaluate the quantity and quality of an initiative or activity. The overall appearance worked well for country-level assessment, whereas the sector-specific assessment was confusing. The tool allowed generation of actionable outputs that the stakeholders could discuss during the assessment. An extra level of information could be considered for OH aspects by applying e.g. the NEOH approach. The workability was low in terms of required data and analysis, but high regarding number of people needed to complete the evaluation. Some days were required to apply the tool fully.

Summarising the results of the SWOT-like assessment showed that the evaluators liked the progressive approach to tackle the implementation of the NAP through different focus areas and stages of development towards a OH plan. Moreover, the tool includes the most important topics without going in too much detail and spots the actions to be taken. It was easy to complete and made sense, at least from a veterinary point of view. The terminology allowed for different ways of interpreting certain words. All key stakeholders need to be represented to do a thorough assessment. The tool was found to be irrelevant for regional or small-scale action plans, and it is not meant for comparison between countries, but rather for informed decision-making at country level. The tool covers the environment (e.g. AMR in sewage or faecal fertilizers), but not surveillance of AMR/AMU in humans. Hence, it mainly covers aspects of relevance for the human clinical setting related to the development of AMR in agriculture and food production that might spread to humans. The extent of implementation of the operational activities is quantified in the tool, but not the quality of the activities.

3.2. The NEOH tool

NEOH is a generic tool for evaluation of OH-initiatives. Hence, using it for evaluating specific integrated AMR surveillance activities would require a thorough description of the context, including description of the relevant sectors and interactions between them, other surveillance activities as well as how AMR develops and spreads in the context, together with a general description of the AMR surveillance programme to be evaluated (i.e. the initiative being evaluated). This is necessary to identify dimensions, levels and scales in the underlying system to target in the evaluation. However, it would take several weeks and multiple information sources to do. The second step, the description of the surveillance activities, requires interviews with administrators and surveillance actors. The process evaluation (OH-ness) addresses how the surveillance activities match the underlying system, planning and working as well as infrastructures supporting the surveillance activities (leadership, collaboration, communication, learning and sharing of information). This requires interviews with multiple actors and stakeholders and reading of historic reports, protocols etc.

It was found that it would be difficult to embark on the NEOH-approach to evaluation, which obviously requires training to perform using a systems approach. There is some guidance in the Excel tool that comes with the NEOH evaluation package, but it is hard to understand for people who have not taken part in the development of the tool or who have not been trained in the use of it. However, once the Excel tool is filled in, it is very useful as the associated illustrative web-diagrams enable identification of potentials for improving the OH-approach in the integrated surveillance. An example of the NEOH tool outputs is shown in Fig. 2.

3.3. The SURVTOOLS

The SURVTOOLS can be used to make an evaluation plan (framework) for any surveillance programme. It also consists of a tool supporting evaluation of technical effectiveness (statistical/epidemiological tool). The current version does not entirely facilitate evaluation of OH. The guided process of defining the evaluation context and questions is not fully self-instructive, but the Wiki helps with its detailed instructions. The layout could be improved. Information on how to conduct an evaluation of the technical performance of one or several surveillance components, as well as the processes and comprehensiveness, is provided by giving scientific references to methodology. Hence, knowledge of how to read and interpret scientific methodology is required. SURVTOOLS does not include guidance for evaluation of the laboratory part. However, detailed design of the components could be included - allowing efficiency of laboratory protocols to be evaluated. One person can complete the evaluation, but information about the surveillance system would have to be collected from stakeholders e.g. by questionnaires or interviews, and the resources required for this would depend on the size and complexity of the surveillance activities being evaluated.

The structure and guidance enabled identification of the correct evaluation questions, although insight into veterinary surveillance systems and integrated OH systems is necessary to select the right evaluation questions. If data are gathered accordingly to the scientific principles described in the references in SURVTOOL, the results would enable comparison of results between countries.

The figure to illustrate the degree of complexity related to the scale of evaluation facilitates thinking about whether all necessary aspects that contribute the overall purpose (ultimate outcome) of the surveillance are included in the programme. Moreover, it made us think about how well the necessary aspects are implemented (and integrated) to contribute to reach different outcomes. The

ultimate outcome of the evaluation is whether the levels of integration support the overall purpose of the programme; that antimicrobials can be used effectively for treatment in humans and animals in the future. An intermediate output of the evaluation could be generation of awareness. Conducting a full evaluation or including many of the evaluation questions in SURVTOOL would require a lot of time and resources. SURVTOOLS also provides a statistical tool consisting of an "epi-calculator" for estimation of sample sizes, performance of tests and design of surveys for different purposes, including declaring freedom from diseases. Hence, evaluations of technical effectiveness would be the simplest and less time consuming to do with this tool.

4. CONCLUSION

The three evaluation tools have each their strengths and weaknesses in evaluating the different areas and levels of surveillance systems. AMR-PMP and NEOH represent the most adequate tools, if the objective is to undertake a thorough evaluation of the entire surveillance system, including generating a discussion among stakeholders and identifying gaps in implementation of a NAP. NEOH is the only tool that focuses on all OH-elements including learning and sharing. AMR-PMP includes several pre-chosen aspects/initiatives of AMR that can be undertaken at different levels. Finally, SURVTOOL is a framework providing information and references on how to evaluate technical effectiveness, process and comprehensiveness of surveillance programmes. The use of all three tools requires the evaluator to be trained for the tools to be used appropriately. Moreover, knowledge about the surveillance programme is required in the evaluation team or in people assisting the evaluation team. It is important to carefully consider the objective of the evaluation prior to choosing evaluation tools, evaluator and participants. Performing evaluations, e.g. by use of the presented tools, and consecutively adjusting integrated AMR surveillance activities and NAPs are likely to contribute to ensuring effective antimicrobial treatment options for humans and animals in the future.

CONFLICTS OF INTEREST

LRN was involved in the development of the NEOH tool. KM was involved in the development of the AMR-PMP tool.

FUNDING

The study was part of an effort to improve guidance on AMR-surveillance evaluation (CoEval-AMR) funded by a research network grant (MR/S037721/1) under the EU Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) Network Call on Surveillance 2018: https://www.jpiamr.eu/supportedprojects/7th-call-results/

ACKNOWLEDGEMENTS

Laura Tomassone, University of Turin, Italy, Ilias Chantziaras, Ghent University, Belgium, and Marie Uttenthal Kjærsgaard, University of Copenhagen, Denmark, are acknowledged for contributing to the project.

CONTRIBUTION

LN, LA, MS and JEI contributed equally to the conceptualization of the study. All authors contributed to the evaluations, reviewing and revising the full manuscript.

REFERENCES

1. Aenishaenslin C, Häsler B, Ravel A, Parmley J, Stärk K, Buckeridgee D. Evidence needed for antimicrobial resistance surveillance systems. Bull World Health Organ 2019; 97:283-9.
2. Bordier M, Uea-Anuwong T, Binot A, Hendrikx P, Goutard FL. Characteristics of One Health surveillance systems: A systematic literature review. Prev Vet Med 2018 [Epub ahead of print]. DOI: 10.1016/j.prevetmed.2018.10.005.
3. Calba C, Goutard FL, Hoinville L, Hendrikx P, Lindberg A, Saegerman C, Peyre M. Surveillance systems evaluation: a systematic review of the existing approaches. BMC Public Health 2015;15:448.
4. DANMAP 2018 - Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. 2019. ISSN 1600-2032.
5. FAO, 2019. Food and Agriculture Organisation of the United Nations. FAO Progressive Management Pathway for Antimicrobial Resistance (FAO-AMR-PMP). www.fao.org/antimicrobial-resistance/en/
6. Peyre M, Hoinville L, Njoroge J, Cameron A, Traon D, Goutard F et al. The RISKSUR EVA Tool (Survtool): a tool for the integrated evaluation of animal health surveillance systems. Prev Vet Med 2019; 173, 1047772.
7. Rüegg SR, McMahon BJ, Häsler B, Esposito R, Nielsen LR, Speranza CI et al. A Blueprint to evaluate One Health. Front Vet Sci 2017; 5:20.
8. Rüegg, SR, Nielsen LR, Buttigieg SC, Santa M, Aragrande M, Canali M et al. A Systems Approach to Evaluate One Health Initiatives. Front Vet Sci 2018a;5:23.
9. Rüegg SR, Häsler B, Zinsstag J. Integrated approaches to health. A handbook for the evaluation of One Health. 1st ed. Wageningen Academic; 2018b. www.wageningenacademic.com/doi/book/10.3920/978-90-8686-875-9

Table 1. Assessment of three selected tools for evaluation of AMR surveillance programmes based on a scoring system with 10 criteria and a scoring scale from 1 to 4 (1 = not satisfactory, 2 = major improvements needed, 3 = some improvements needed, 4 = satisfactory) in criteria 1 to 6

Criteria number	**Evaluation criteria and scores**	**AMR-PMP**	**Comments**	**NEOH TOOL**	**Comments**	**SURV-TOOLS**	**Comments**
1	User friendliness	4	Easy to understand and fill in	2	Hard to understand some of the questions in the tool (e.g. in 'the Thinking sheet' in the Excel tool), especially without prior training	3/2	Easy to fill in the tool: 3 More complex to conduct the evaluations: 2.
2	Meets evaluation needs /requirements	3	Evaluating quantity and quality needs to be better addressed	4/2	For overall system features it meets the evaluation needs (4) For specific technical details (e.g. laboratory part of surveillance) it is less intuitive to use (2)	3	The epidemiological performance of a surveillance system e.g., effect of number and type of samples collected, and limit of detection would be the easiest to evaluate
3	Efficiency	4	Easy to fill in	2	It takes a long time to fill in the tool	3	It takes some time to fill in the tool
4	Overall appearance	4/2	4 for the general assessment 2 for the sector-specific assessment, that was confusing and disappointing	2	The Excel tool is too compressed in the layout. It is best to be an experiences Excel user and to have a large screen to work on	3	Support the process of making a framework for evaluation. If the evaluations are conducted according to the given framework the results are objective and scientific valid. It would be time consuming to conduct the evaluations for ecosystems that require integrated surveillance.
5	Generation of actionable evaluation outputs	4	Actions can be agreed by the stakeholders during the assessment	4	The web-diagrams make it easy to identify where to put focus on gaps in the surveillance.	1/3	Filling in the tool will not give actionable outputs (1). To use the generated evaluation plan could produce actionable outputs for efficiency of testing system whereas for structure and process is not clear whether it would be possible to get actionable outputs (3)

6	Allows evaluation of OH aspects	3	Not addressed particularly. An extra level of information could be considered for certain aspects by applying the NEOH approach	4	This is a major strength of the systems approach and the tool	2	Not addressed particularly in the tool (only animal components possible to add), but tool could in principle be applied to all types of surveillance systems.
7	Workability in terms of required data (1: very complex, 4: simple)	4	Apparently simple	1	Fairly complex tool to use, and it requires sufficient effort to gather the required information through interviews of essential actors and stakeholders and other/written information	4/1	To fill in the tool to acquire an evaluation framework (4). To conduct evaluations, it will be dependent upon the defined evaluation questions (4/1)
8	Workability in terms of required people to include (1: many, 4: few)	1	All stakeholders need to be represented or present (1) to do the evaluation	1	Need to interview all essential actors and stakeholders. One evaluator can perform the work over time	4	In theory one person could do it – it is necessary to gather information from all relevant stakeholders, but it could be done by questionnaires or interviews
9	Workability in terms of analysis to be done (1: difficult, 4: simple)	4	Mostly yes/no answers to questions	4	Once the tool is filled in it provides good support for the analysis	4/1	Depends upon the defined evaluation questions whether complex analysis or not.
10	Time taken for application of tool (1: > 2 months, 2: 1-2 months, 3: 1 week to 1 month, 4: < 1 week)	4	Can be done in some days	3/1	Filling in the tool can be done in 1 week - 1 month (3). But to interview and synthesise the information for the evaluation could take longer (1)	4/1	Filling in the tool can be done in < 1 week (4) – but to conduct the evaluation could take longer (1-2)

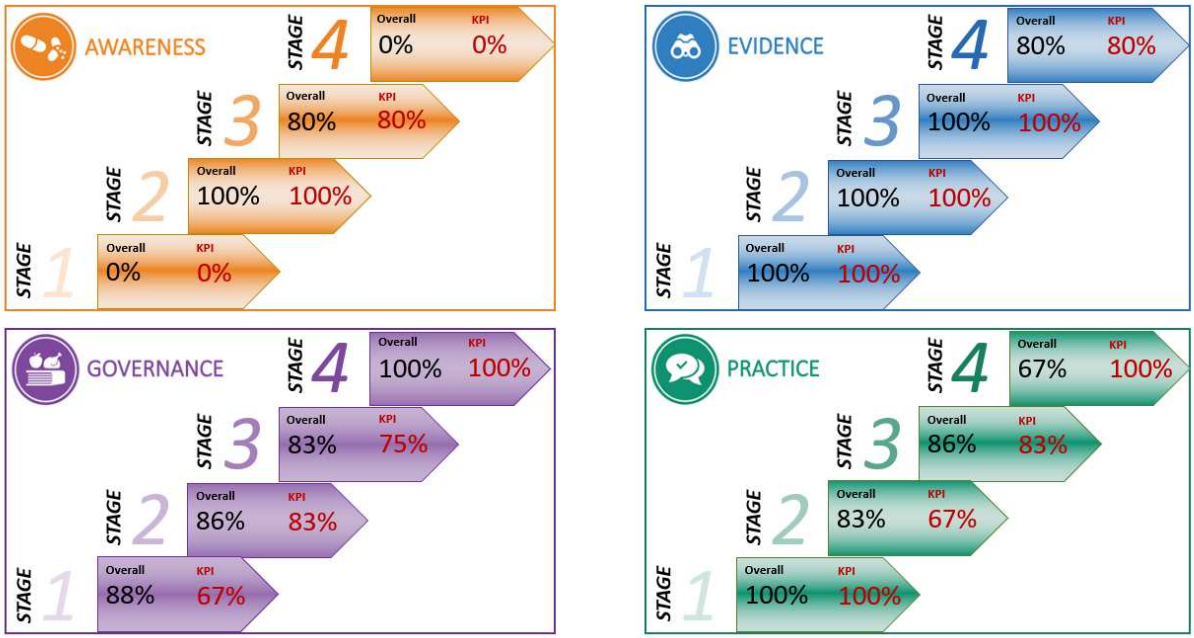


Fig. 1. Dashboard showing how the AMR-PMP tool is set up.

Fig. 2. Fictive example of an output generated by the NEOH tool after a full evaluation: a web-diagram illustrating potential gaps in the OH approach in the evaluated initiative. The tool also provides detailed web-diagrams for each of the six evaluated OH elements.